HANDICRAFT

LESTER
GRISWOLD

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BY

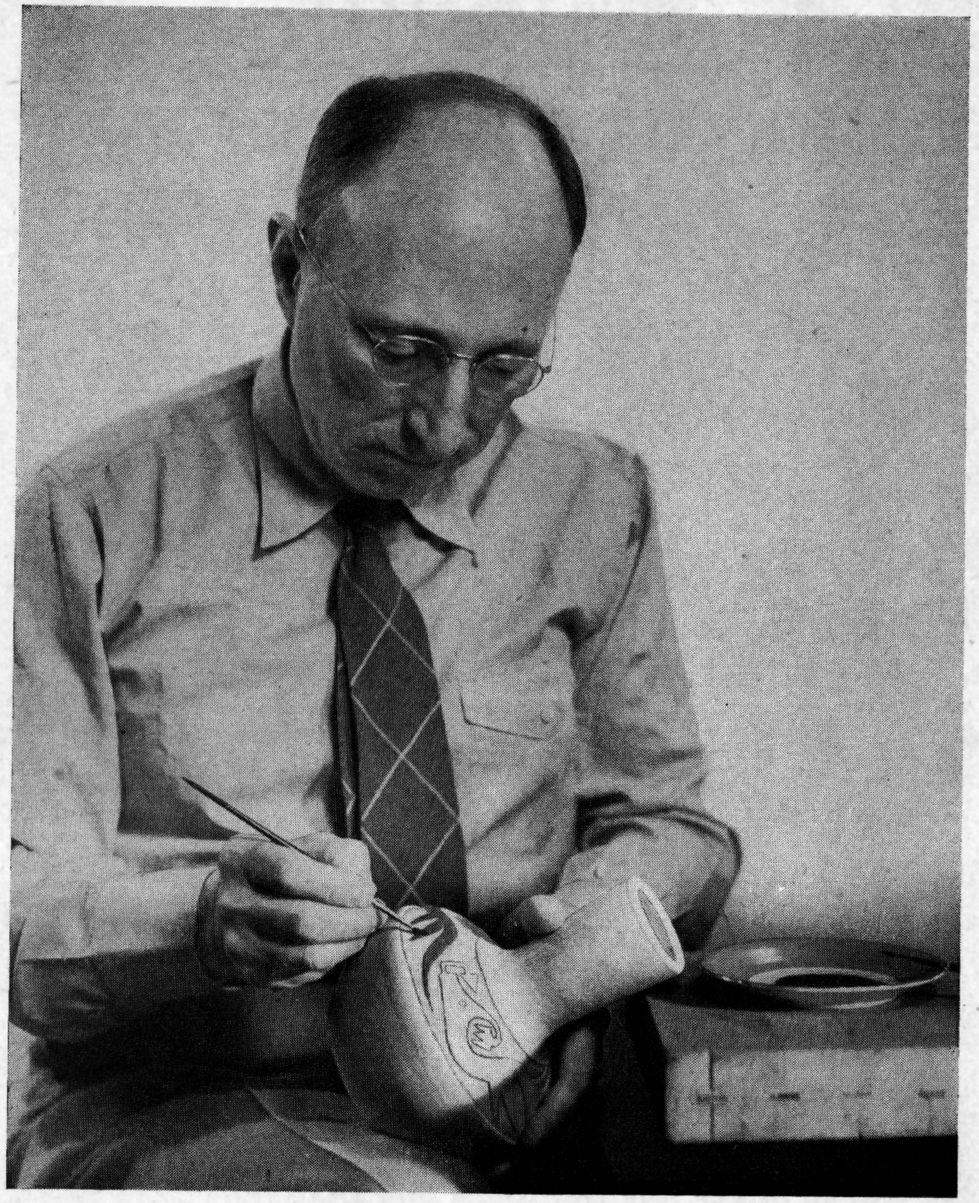
LESTER GRISWOLD

HANDICRAFT

SIMPLIFIED PROCEDURE AND PROJECTS

"A Craftsman's Creed"

"All of the fine traditions and the skill . . .
Are mine to use to raise my craft's renown,
And mine to teach again with reverent will . .
Thus do I love to serve,
With fingers that are masters of the tool."



"Let us improve our standard of living thru better Craftsmanship"

Lester Griswold

HANDICRAFT
SIMPLIFIED PROCEDURE AND PROJECTS

EIGHTH EDITION

By

LESTER GRISWOLD

Eighth Edition

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PREFACE

Handicraft was written to portray the elements of essential skills through graphically illustrated and explicit descriptions. Procedures are shown sequentially in a form readily understood and followed, so that the basic craft technique may become the personalized skill of the individual craftsman. Subject matter in this form makes leisure time pursuits a constructive activity and stimulates creativeness, the human quality which finds satisfaction only in "doing."

We have not restricted the projects in this book by "simplified procedure" to the extent that they should be classified as belonging to an elementary treatise on craftwork. Neither was it our intention, through emphasis given to detail, to make the contents exhaustive, complex nor burdensome. Rather, we sought to discover precision in methods, progression in skill sequences in the several crafts explored and embody the findings of our research in this Manual.

It is our hope that the instructor, occupational therapist and individual craftsman will here find the array of projects presented sufficiently wide in range of interest material, skill content and achievement possibilities to permit planning a Handicraft program to fit several age levels. Continuity of interest in handwork from one age level to the next should be cultivated. This necessitates using projects requiring increased facilities, additional knowledge of materials and techniques. In the upper age levels it is essential that something of value be produced, which in the making provides opportunity to satisfy the desire for mastery and brings the reward of achievement.

In assemblying the subject matter presented in Handicraft, I am greatly indebted to my wife Kathleen who has collaborated from the beginning in our attempt to make each edition more satisfactory than the last.

SUBJECTS

Leatherwork—Stamped, Carved, Tooled, Thong Plaiting, Knot Tying, Rawhide.

Plastics—Synthetic Resins.

Metal Work—Copper, Pewter, Silver—Stamped, Tooled, Pierced, Etched, Chased—Cast—Jewelry Making.

Woodwork—Carving, Marquetry, Pine Furniture Construction.

Archery—Bow, Arrow, Construction—Use of Equipment.

Fabric Decoration—Batik, Block Printing, Silk Screen.

Rope—Cordage—Yarn—Horsehair—Knot Tying, Splicing, Square Knotting, Netting, Knitting, Halfhitch Work.

Pottery—Coiled Ware, Slip Cast Pots, Tile.

Weaving—Southwestern Navaho and Spanish.

Stone—Alabaster—Gem Cutting and Polishing.

Primitive Indian Crafts—Beadwork, Horsehair, Porcupine Quill, Featherwork, Stone Flaking, Silversmithing, Rawhide, Leatherwork.

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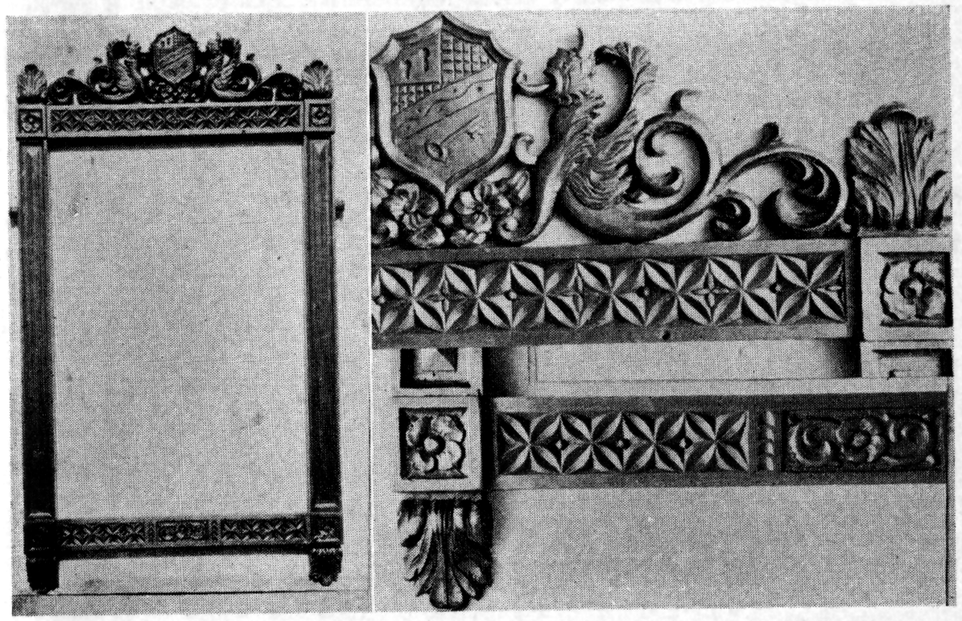
CRAFTWORK IN LEATHER

Tooled Leather Craftwork

CRAFTWORK IN WOOD



A Wall Mirror Frame—showing use of geometric design in combination with other design elements.

A TOOL KIT SERVICE—INDEX

Handicraft in some form enters into a group work program at all age levels. Interest may be aroused if the work is creative. How successful the program may become depends on the opportunity afforded for individual participation.

A learning experience for the individual is necessary at all times to sustain his interest in the activity of the group. This learning experience must grow and expand into larger fields. In order that individual interest in craftwork (skills, technics, knowledge and use of tools and materials may be extended and enriched), the following enabling plan is offered.

1. Provide a Central Tool Supply service on a requisition basis.
2. Make available Tool Kits containing a minimum set of Tools required for doing specified craftwork projects.
3. Permit responsible organizations to requisition these tool kits for a period of limited duration. This period may be limited somewhat by the number of kits available and the demand.

In a limited way this Circulating Tool Kit idea has been tested in one community, it is definitely popular, and seems to meet real need.

Scoutmasters welcome the service. It sustains boy interests in the Scouting Program, and stimulates advancement. It also enriches the program by making possible more creditable work to be done by the boys. Adequate tools to do the job specified in the Merit Badge Program may be had on requisition under this "Circulating Tool Kit Service."

Teacher groups have found the "Tool Kit" idea makes possible opportunity for getting "recreation and diversion" through a creative activity. In addition to diversion and the use of adequate "tools and other equipment" an opportunity for skill acquisition in craftwork is definitely established. This group has discovered through these learning experiences that present day tensions are let down during "leisure time" periods. Besides being refreshed and better qualified to carry on their work, they find stimulation to greater creative effort under the incentive of being able to have adequate tools and facilities to carry out their ideas.

Rural groups especially have found the Tool Kit idea of genuine service. They are striving to have the plan established on a permanent basis, also extended to include the circulation of power tools. Definite plans for several communities to participate in the "Lending Tool Kit" plan and contribute to the "maintenance fund" through group effort is already under way.

TOOL KIT CONTENTS

Leather Working Tools

Awl—Handles, Hafts.
Awls—Saddlers, Harness, Shoemaker's Curved, Thong.
Barbours Linen No. 12.
Bees Wax.
Cutting Block—Pine End Grain.
Design Sheets.
Dividers—Compass or Beam Type.
Draw Gauge.
Dressing Cleaner—Saddle Soap.
Dye Colors.
Edge Beveler, Creaser.
Edge Burnishing Wax—Colorless, Brown, Black.
Findings—Snap Fasteners, Rivets, Eyelets, Jewelled Ornaments, Buckles, Swivels, Rings, Dees, Snaps.
Incising—Knife, Swivel Cutter.
Knife—Skiving, Thong, Rocker, Extension Blade Knife.
Leather Punch—Rotary 4-tube with hole spacing gauge.
Mallet—Wooden.
Marlin Spike.
Modelers—Tracers, Creasers, Deerfoot, Spoon.
Needles—Glovers, Harness — Egg Eyed, Blunt, Leather Lacing.
Oil Stone—Coarse-Fine Surfaces, Oil and Leather Strap charged with Jeweler's Rouge.
Patterns—
T. L. P. Tooling Leather Patterns.
S. L. P. Strap Leather Patterns.
Punches—Belt Type, Drive Punch, Sizes No. 1, 2, 6, 8.
Punching Block—Hardwood End Grain.
Shears—8 inch.
Skiving—Stone, Marble, Plate Glass. Size 8x10.
Snap Fastener Tools.
Stamping Tools—Set No. 1; Set No. 2; Special Set 1 to 31. Saddlers Stamps No. 50-64.
Stitching Wheels—5 and 7 stitches per inch.
Thong Chisel—One prong, three prong.
Thong Cutter.
Wooden Creaser.

TOOL KIT CONTENTS

Silversmithing Tools

Abrasives—
Scratch Remover—Tripoli on buckskin.
Polish—Crocus on Buckskin.
Pumice Stone, fine.
Acid Bath—
10% Nitric Acid for Nickel Silver.
10% Sulphuric Acid for Sterling Silver.
Antiquing Fluid and Brush.
Anvil Block—Grooved for Stamping Triangular Bracelets. Base drilled for Ring Mandrel. Mortised for V-Notch Sawing Block and Vise.
Asbestos Sheet—¼"x12"x14"
Borax Flux—20 Mule Team.
Borax Slate and Brush.
Binding Wire—Soft Iron.
Burnisher—Curved.
Charcoal Block.
Crucible—Pottery, Fire Clay or Graphite.
Design Sheets.
Drill—Hand Twist Drill, Set Small Twist Drills.
Files—
6" Flat, No. 1 and No. 5 Cut.
6" Half Round, No. 1 and No. 5 cut.
Needle Files, Assorted.
Fire Brick—Two for Torch Baffle.
Findings—Shapes, Bracelet, Ring, Brooches, Conchas, Scrap Sterling Silver, Hinges, Catches, Pins, Links, Jump Rings, Fox Tail Chain, Sheet Metal, Wire.
Hammer—Ball Pein.
Jeweler's Saw—5", Nos. 3/0 and 4/0 Blades.
Lead Sheet—⅛"x2"x4".
Mallet Wood.
Nitric Acid—Glass Stoppered Bottle.
Pitch Bowl.
Pliers—Round Nose, Flat, Gas, Diagonal Cutter.
Ring Mandrel.
Sand Bag.
Sand Tray.
Snips—Metal Shears.
Solder—Hard, No. 1-2-3 Melting Point Range.
Soldering Tool—Probe Made from Bicycle Spoke.
Stamping Tools—Matrix and Die Blocks. Sunburst and Rain Drops.
Sulphuric Acid—Glass Stoppered Bottle.
Tongs—Crucible, Soldering.
Torch—Plumbers Blow Torch, Prestone.
Turquoise—Rough, Polished, Dopp Sticks, Wax, Sand Paper No. 1½ Candle.
Tweezers—Soldering, Clamp Forceps.
Water Bath—Paper Towels.

Pewter Working Tools

Alcohol—Self Generating Blow Torch.
Alcohol Lamp and Mouth Blow Pipe.
Asphaltum Varnish—Brush.
Bench Vise—to hold raising stakes.
Chasing Tools.
Contour Blocks—Wood.
Crucible, Tongs.
Cushions—Felt, Newspaper.
Design Sheets.
Etching Bath—20% Nitric Acid.
Files—Flat, Half Round, Single Cut, Sheer Cut.
Findings — Shapes, Discs, Napkin Clips, Ornamental Shapes, Brooches, Pins, Clips, Catches, Scrap Pewter, Sheet Pewter.
Flux — Soldering Glycerine and Hydrochloric Acid.
Jeweler's Saw—5", Nos. 3/0 and 4/0 Blades—V-Notch Block.
Metal Shears.
Mallets—Wood, Horn, Rawhide.
Nitric Acid—Glass Stoppered Bottle.
Plaster of Paris Molds.
Sand Bag.
Scraper—Three Cornered.
Solder—Soft, Tin Lead Alloy—50-50, 70-30, 60-40, in Wire Form.
Stakes—Raising Anvil.
Torch—Gasoline Blow Torch.
Turpentine—Bath.
Water Bath—Paper Towels.
Wooden Shaping Stakes .

Primitive Crafts—Tool Kit

Beadwork — Needles No. 14-2", Thread, No. 40 Cotton, 4/40 Cotton Warp, Awl, Knife, Sinew, Buckskin.
Bone Horn—Drill, Twist; Pump, Bits and Pivot Point; Saw, Jeweler's 5" No. 4/0 Saw Blades, Scrapers. Files—Rasps, Single Cut, Shear Tooth, Flat, Half Round, Round Taper. Abrasives—Paper, Cloth, Grits, Pumice, Linseed Oil. Engraving Tools—V and Flat. Monogram Filler.
Feather Work—Pliers, Round Nose, Flat. Needles, Thread, Awl, Shears, Punch, Mallet, Knife, Cement.
Stone Flaking—Bone, Antler Tip, Leather, Palm Protector.

Woodworking Tools

Abrasives—
Garnet Papers—Nos. ½, 0, 00, 000.
Carborundum Papers—60 to 100.
Wet or Dry—100 to 400.
Brace and Bits—⅛" to 1".
Chisels—½" Skew, double bevel; ⅛" square corners, ¾" Straight, ½" Straight, round corners; ⅛" Veiner; Gouges, 3/16" Short Radius; ⅜" Short Radius; ⅜" Medium Radius; ⅜" Long Radius.
Files—⅛" Round; 8" Wood Rasp.
Finishing Materials — Shellac, Denatured Alcohol, Turpentine, Linseed Oil, Varnish, Thinner, Rubbing Compound, Wax, Shellac Stick, Sanding Sealer, Lacquer.
Glue — Hoof Glue (glue pot), Casein, Plastic.
Hammer—Claw.
Oil Stones—1 (Medium Fine) 1½"x6". Set Arkansas Slips, 3 styles; 1 taper pencil.
Mallet Wood.
Miter Box.
Nails — Assortment Box and Finishing Nails. Brads, Wood Screws.
Pencil Compass.
Planes—Jointer, Jack Corners, rounded for Hewing.
Rubber Bands—Cut from Auto Inner Tubes.
Rule—Folding, Steel Tape.
Saws—Hand Saw, Cross Cut, Rip, Fret Saw. Jeweler's Saw, Nos. 2/0, 4/0, 8/0 Saw Blades.
Spoke Shove.
Sharpening Kit—See Oil Stones. Leather Strop charged with Jeweler's Rouge.
Square—Carpenter's, Try, Bebel.
Veneer Straight Edge—⅜"x¼"x18", cold rolled steel.
Work Bench—Vise.

INTRODUCTION

We must turn from the machine made products of modern life to contrast the lasting value and charm of almost anything made by hand. Something is contributed by the personality of the maker, expressed by the skill and effort with which he worked, that enhances the value of anything to the extent that it is hand wrought. We almost instinctively realize this value and our appreciation is part of the heritage of the past.

The beginnings of craftwork go back beyond the traditions which preceded history, back to prehistoric man, from whose relics we know, that one of the first steps toward civilization was taken when he learned to fashion crude weapons and implements which he soon began to decorate with a surprising degree of artistic skill. The earliest material seems to have been stone, then bone and ivory which were first engraved then later inlaid with metals and combined with wood in the making of handles, which were attached or "hafted" with thongs to knives or axes of flint.

Metal came into use in the Iron and Bronze Ages and articles for decoration as well as for utility were constructed. Gold was soon after introduced and the art of making colored enamels was developed. By this time man had learned to make furniture for his dwellings, altars and images for his temples, increasing his skill and improving his workmanship through the centuries until we find the first written accounts of his craftwork in the records of ancient Egypt, in Greek literature, and in the Bible. Through the Dark Ages some of the attainments of the ancient crafstmen were lost, but many others were fortunately preserved in the abbeys and monasteries where later they were brought to a high degree of perfection, as in metal working wood carving, tapestry weaving and the embossing of leather bindings for hand written vellum manuscripts.

With the revival of civilization in the Middle Ages, the cherished knowledge and skill of the monks was restored to the people and the development of crafts through this period is closely linked with the history of the Guilds. A thoroughly fascinating and authentic picture of the medieval craftsman is presented by Katherine Gibson in a library volume "The Goldsmith of Florence" which is termed "A Book of Great Craftsmen." It will charm and inspire the modern craftworker and should be read by all who would catch the spirit of this great age of Arts and Crafts.

In this country we have a twofold heritage of attainment in Arts and Crafts, that of the early American colonist who brought from Europe the best of the culture of his native land, and that of the first American, the Indian, whose decorative arts were developed centuries before the coming of Columbus. His contribution to American culture is only now being recognized and appreciated and noteworthy efforts are being made to restore and preserve for both the Indian and the white man his music, his tribal pageantry and especially his decorative arts, which are largely the symbolic expression of Indian history, philosophy and religion. A sympathetic study of these two contrasting streams of culture should encourage and inspire us to adapt in our own work as much as possible of the unique beauty and charm of both the Colonial and Indian arts and crafts.

NECESSITY FOR DESIGN IN THE HANDICRAFT PROGRAM

Man's handwork either pleases or offends. Its acceptance or rejection is based on the extent to which it embodies certain specific qualities or conforms to definite predetermined characteristics considered satisfying. Basically a good craftwork item must (1) serve some useful purpose; (2) be made of material considered durable and adequate; also (3) embody qualities and characteristics which give the possessor some satisfaction.

This yard stick for critical examination of handicraft should reveal whether the article is evolved in a haphazard, hit or miss manner or whether it is the expression of a clear, systematic plan, visualized in the mind in advance of the making. A good design results as the specifications are developed which embody the satisfying conditions of utility, durability and beauty.

Design is good order and orderliness comes from following some method of arrangement. To discover and identify the principles whereby the good order and the best arrangement may be achieved has been man's quest through the ages. As individuals continue the search, their findings though fragmentary, provide stimulus and incentive to better work and more adequate expression of creative urges. The efforts of these craftsmen who constantly seek to improve their skill in the art of portraying beauty enrich life for their fellowmen. It is significant that masterpieces have come from obscure individuals who labored with diligence and intelligence to achieve a desired result. No one should be discouraged by the apparent gap between the result of his effort and that of the recognized artist or master craftsman. The learning experience justifies the attempt and since it is the privilege of each person to be a designer in some degree, his work will reveal the extent to which he has been able to employ the basic principles in creative expression.

Accuracy and application may be learned through handicraft. It is essential that a handicraft program emphasizes equally the importance of good design and the mastery of skills in the manipulation of tools and materials. The teacher who understands the principles of both these essentials and who can inspire appreciation for them, as well as impart the knowledge of techniques, has increased ability to enrich the learning experiences of individuals in youth and adult education.

PRINCIPLES OF DESIGN IN HANDICRAFT

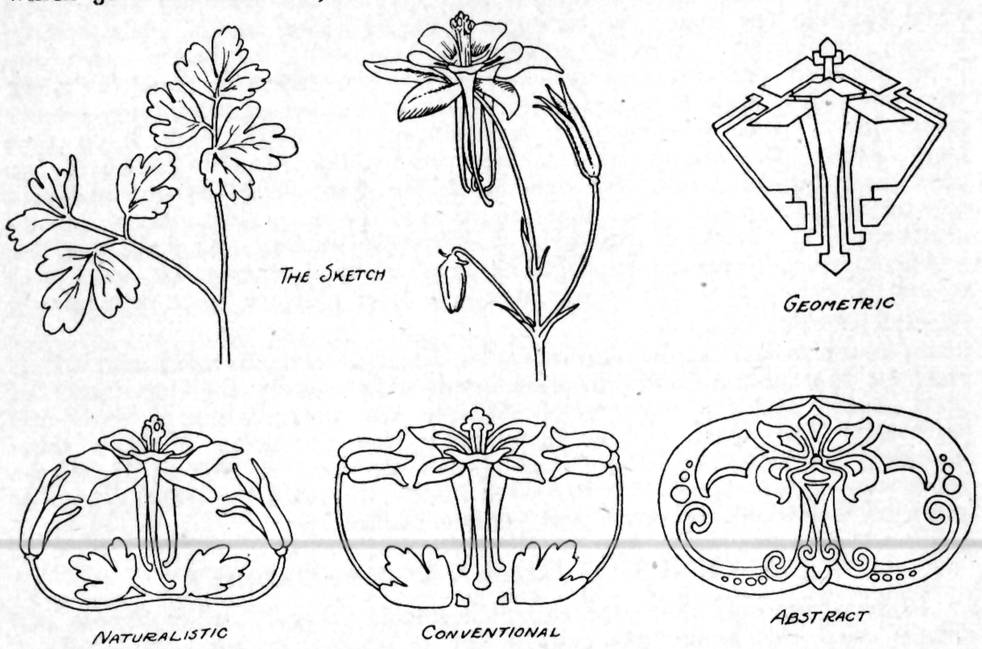
It has been said that "the end of design is properly utility, fitness and delight" and this seems particularly apt as applied to hand work. As a painter must know his pigments and the principles governing color shades and harmony, so the craftsman should be familiar with the materials, processes and the skillful use of the tools required for a given craft. "Only one who practices a craft can successfully design for it," is a principle essential to the mastery of all handicraft.

The choice of elements and the development of a design must be governed by the nature of the material and the mode of application, as every material has its limitations and its possibilities. In the selection of design for form or ornamentation, consideration must be given to the qualities of surface and structure possessed by the medium to be employed. The achievement of "utility, fitness and delight" in any piece of handwork is greatly influenced by these inherent qualities: the hardness or grain of wood, the plasticity of clay, the texture of leather, the ductility of metal, and the varying degrees of each quality in the different kinds of each material. Surface textures and finish also influence the kind of decoration or enrichment which is pleasing; the angle and degree of reflection in metal, the color and contrast in wood grain, the characteristic textures peculiar to leather of different kinds.

Principles of Design in Handicraft

The possibilities of handicraft as an expression of the genius, inspiration and skill of an individual, are greatly enlarged by the understanding and application of art principles: **repetition, radiation, proportion, balance and emphasis.** Not only will this understanding enable the craftworker, whether a beginner or a master craftsman, to design an article of beauty and utility, but it will contribute immeasurably to his appreciation and enjoyment of the fine arts.

The fundamental art principles have all been derived from nature, which has been rightly called, "the great reservoir of ideas." Analogies and concepts from plant and animal life are immediately suggested by the terms; harmony, balance, proportion and the other art principles. The geometrical arrangements of plant development makes possible its transition and adaptation to design in form and ornamentation. In the illustrations the principles which govern natural objects and examples of derived designs are shown.



Design elements in leaves, flowers, seed pods and spirals provide fundamental shapes. Practical applications in the form of borders and all-over designs are suggested by natural motifs. Spirals in flowers and in shells and sea urchins present the principles of growth, radiation and repetition. Studies in fundamental growth are afforded by fish. Animals serve to illustrate action, proportion and individual character. The study of birds, a field beautifully organized, contributes a wealth of material for interpretation in design. Silhouettes, patterns of the body showing carriage, balance, and individual type, may be caught in quick sketches. Details of feather patterns are also invaluable as reference material. Insects also afford source material for decorative design. Structure of body and pattern of markings in almost unlimited variety show principles of symmetry, balance and proportion.

"Research Design in Nature, Volumes I and II," John Gilbert Wilkins, 1926. Distributed by the Practical Drawing Company, 1315 South Michigan Boulevard, Chicago. This is a compilation of plates (268), made from studies by students in the School of the Art Institute, Chicago. Mr. Wilkins' classes in research were privileged to use the vast wealth of material collected and preserved by the Field Museum of Natural History.

Suggestions for Developing a Structural Design

Given a well-thought-out-design, the principles to be followed in working out the idea on paper are most important. The design is first visualized as a single mass or solid, having approximate dimensions of width, height and thickness. This form is called the "primary mass" and details of appendages, such as handles, spouts or knobs, are later worked out in proportion to the predetermined whole.

The accepted rule for proportion is stated as, "a primary mass must be either vertical or horizontal according to the intended service, unless prohibited by technical requirements." A mass is horizontal when its largest dimension is horizontal, or vertical when the reverse is the case.

It has been found that those stimulating qualities which arouse interest are in balance within areas enclosed by rectangles. The eye seeks to find the dynamic quality in all spaces and since eye movement in areas is measured by the percentages of height in relation to width or vice versa, it is possible to indicate the upper and lower limits for design proportions beyond which the ratios would be unsatisfactory.

So the first step in design is the construction of the area rectangle having the best proportions for the article according to the service for which it is intended.

The Principle of Width and Height Proportion

Various methods have been used to obtain satisfactory dimensions for the primary rectangle, with ratios for width and height which insures a design of pleasing proportions. The basic principle to be followed conforms in general to those proportions which the eye finds perfectly natural and agreeable. A scale of ratios, which has remained the standard for good proportion through centuries, was established by the designers and architects of antiquity. Tests have determined that these ratios conform to eye movement and also possess the dynamic quality of variation. They are approximately 1 to 3, 3 to 5, 5 to 7, and similar proportions.

The Greek temple builders originated the famous rectangle, known as the "golden oblong" which is considered the most ideal. The geometric ratio of this rectangle is 1 to 1.618, or 5 to 8⅛ approximately, and it may be determined by making the short side 3/5ths of the long side. Another principle discovered by the Greeks applies to the division of space and is state as, "an area is most pleasing divided somewhere between one half and two thirds the length of the area." This rule will be found to apply to any chosen vertical or horizontal primary rectangle.

The Primary Rectangle

In the preliminary sketch, the designer may outline the approximate form of the chosen shape, or "primary mass," and in order to determine whether it will be a vertical or horizontal mass, enclose it free hand in a rectangular area which defines the boundaries. Upon this framework of the primary rectangle, a scale drawing may then be constructed, using the exact dimensions chosen for the development of the design. Fig. 1, Page 22, Sketches 1, indicates the rectangle drawn to enclose a horizontal mass, and Fig. 1, Sketches 2, that for a vertical mass.

In the development of a design, related proportions for width and height in any desired size may be obtained graphically from the primary rectangle by employing the geometrical principle of right angle intersection of diagonals. The method is indicated in Fig. 1.

Horizontal Subdivision of the Primary Rectangle

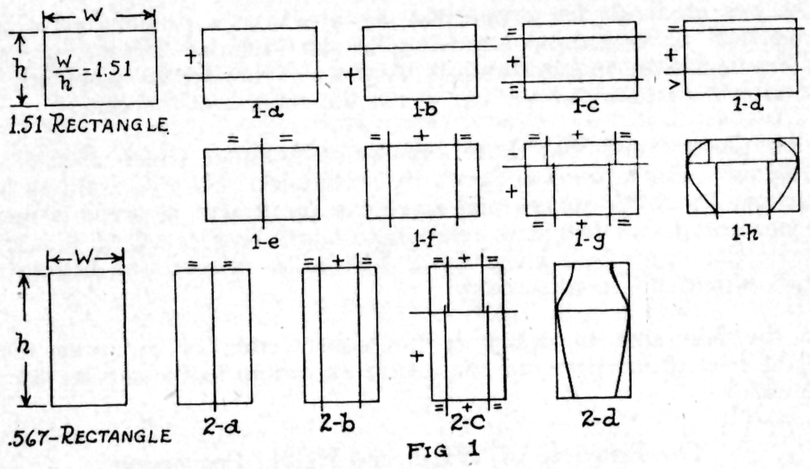


FIG 1

Sketch 1a, Fig. 1, shows a horizontal mass divided into two unequal parts, the upper (lesser and the lower (greater). The area below the dividing line is dominant. In Sketch 1b the area above the dividing line is dominant. In Sketch 1c two dividing lines are used, giving one dominant area and two lesser areas that are equal in size. In Sketch 1d the two lesser areas are unequal.

Sketches 1a-1b indicate a division of the space into two parts unequal in size and in harmony with the Greek rule "between one half and two thirds the length of the area." The larger or dominant space, marked + may be either above or below the dividing line as indicated.

In Sketch 1c-1d, a second line is shown as drawn across the rectangle to make three divisions, one dominant and two subordinate and equal to each other. This line could be drawn so as to make all three spaces unequal in width with one dominant as shown in Sketch 1d. Sketches 2a to 2d show further applications.

Vertical Subdivisions of the Primary Rectangle

Sketches 1e to 1g indicate several possibilities of vertical division, following the same arrangement of dominant and subordinate spaces as suggested for horizontal subdivision. These also correspond to the Greek principle of "more than one half and less than two thirds." Sketch 1h shows how this principle is applied in determining the shape of a bowl.

"Industrial Arts Design," William H. Varnum. Manual Arts Press, Peoria, Illinois.
"Design as Applied to Arts and Crafts," F. R. Smith, Pitman & Sons, New York and London, 1931.

The Principle of Continued Proportion

The following examples of the geometric method of subdividing or extending a primary rectangle into areas of related sizes are based on the principle of continued proportion. The area enclosed within the rectangle shown in Sketch 1 is designated as the rectangle AB. Any rectangle may be identified in this way by the use of two letters. The principle of continued proportion may be developed in any rectangle chosen at random, but for purposes of design selection should be made from the group of specific rectangle previously described. Each of these has basic properties which permit subdivision or expansion according to a definite scale as indicated in the sketches showing the comparative properties of rectangles, Fig. 2.

The rectangle AB has the ratio 1 to 1.51. This may be subdivided as follows:

1. Draw the diagonal line CD as indicated in Sketch 2.

2. Draw the diagonal OB at right angles to CD as shown in Sketch 2. Mark the intersection at O.

3. Extend the diagonal BO until it cuts the top line of the rectangle at point E as shown in Sketch 3.

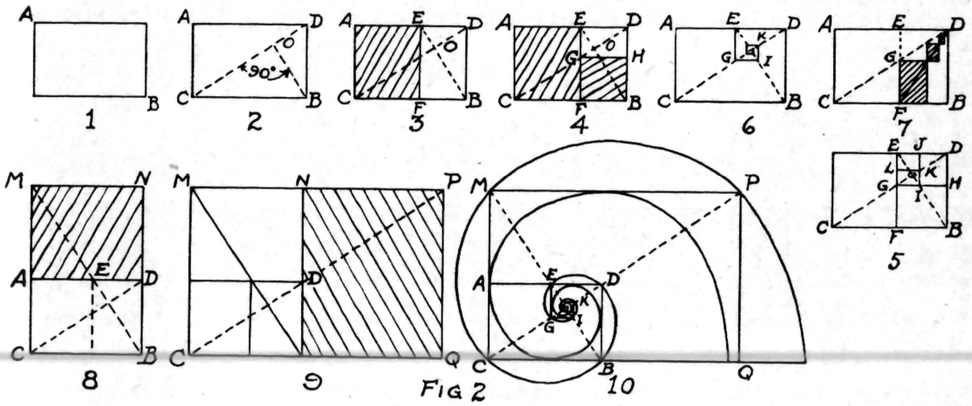


FIG 2

4. Draw the line EF which divides the primary rectangle, AB into two rectangles AF and EB. The smaller rectangle EB known as a "reciprocal" of the "parent" rectangle AB and although smaller in size is similar in shape with proportional dimensions for height and width. The original proportion or ratio of width to height, in this case 1 to 1.51, remains constant in rectangles AB and EB, also in the further subdivisions of the reciprocal rectangle EB.

5. Draw line GH as indicated in Sketch 4, starting at point G where the diagonal CD is cut by line EF. The resulting reciprocal rectangle EH bears the same relation to rectangle EB as does rectangle EB to its "parent" AB. The development of other rectangles by drawing lines IJ and KL, each of which is proportional to the original rectangle AB and to the preceding subdivisions is shown in Sketch 5.

The subdivision of rectangular areas into smaller and smaller sizes is indicated in Sketch 6. At point E a vertical line is drawn to point G th intersection with diagonal CD. At point G a horizontal line is drawn to point I the intersection with diagonal EB. Then a vertical line is drawn to K and so on. This procedure may be continued downward toward infinity.

In Sketch 7 the diagonal of the reciprocal rectangle EB is shown drawn from the corner D to F. The procedure of drawing vertical and horizontal lines between diagonals CD and DF is shown. This gives rectangles the sides and ends of which are all in "harmonious linear relationship" and lie within the primary rectangle AB.

The extension of rectangular areas in larger sizes is indicated in Sketch 8. The diagonal EB is extended to point M. This adds an area MD to the original rectangle AB. In Sketch 9 the rectangle MQ is constructed by extending diagonal CD to point P.

In Sketches 6, Fig. 2, page 23, a rectangular spiral is shown formed by drawing vertical and horizontal lines to points of intersection with the diagonals CD and EB. This rectangular spiral has been extended through points MPQ. See Sketch 10. Also two spirals are shown, one drawn through corners of the rectangles KG-IE-GD-EB-CD-BM-CP. The other spiral is drawn inside the rectangles, tangent to the sides and ends of each.

The Egyptians are credited with the possession of much mathematical knowledge at an early date. Greek travelers in Egypt were intrigued by the skill of native builders in the handling of space relationships both in the construction and ornamentation of their structures.

To one of the Greeks, Pythagoras, goes the credit for extending this knowledge and skill in geometrical procedure and raising it to the rank of an exact science. A few interesting **linear** and **space relationships** based on the **principle of continued proportion** are shown in Fig. 3. Anyone interested in exploring this field of knowledge will find good reading in the *references.

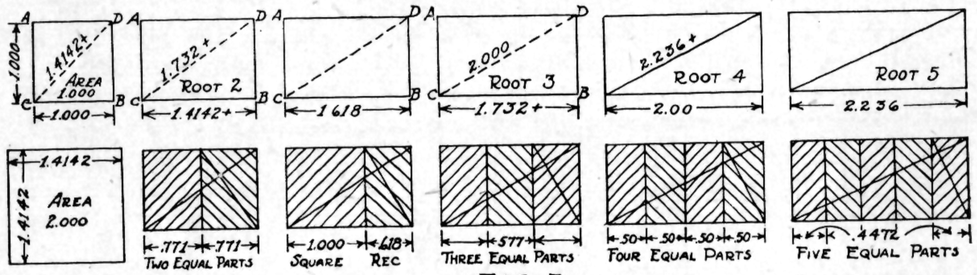


FIG 3

Outlines

Forms bounded by straight lines are considered stiff, rigid and monotonous. As the outline or structural design is developed in accordance with the plan of the primary rectangle and the principle of division, curves are introduced to give grace and variety to the outline, or, depending on the purpose for which the article is intended, vigor, strength and solidity. Three curves, employed in functional and ornamental design are known as, the "curve of force," the "curve of grace" and the "curve of beauty."

The "curve of force" is taken from nature. It is a shape found in the stems of flowers, its **form follows function.** The stem as a support for flowers must possess strength, its beauty of contour is secondary. Many variations of this curve occurs in nature. A method of geometric construction which gives an approximation of its general form is indicated in Sketch A, Fig. 4.

The "curve of beauty," also a derivative from nature, is the **wave** found in rolling prairies, seas, and in "the back of the female figure when in profile." It is a line of beautiful movement and fine proportion.

The "curve of grace" although of mechanical origin, was greatly

*"DYNAMIC SYMMETRY," "THE GREEK VASE," "THE PARTHENON AND OTHER GREEK TEMPLES," by Jay Hambridge, published by the Yale University Press. "DYNAMIC SYMMETRY," same author, published by Brentona, N. Y. "DYNAMA-RHYTHMIC DESIGN," by Edward B. Edwards, Century Co.

admired and used by craftsmen among the Egyptians, Greek and Roman peoples. In borders, the Ionic and Corinthian capitols, in Gothic structures and ornaments the **spiral volute** found application. In the surviving examples "the delicate acceleration of motion in each spiral" is utilized with perfection in feeling and execution. In combinatien with a second volute in the form of a reversed curve it becomes a terminal curve of importance.

The Greek architects frequently made use of curves to support structures or embellish different parts. These curves were designated according to their use. The wavy line or "Cyma" was utilized in molded cornices. Concave and convex curves of varying length were combined as "Cyma recta" and "Cyma reversa" to give continuity and contrast in outline between structural features. To effect a pleasing transition from one portion of a structure to another, the Greek designers used a construction which produced shadows by means of curves, known as "Scotia" (meaning darkness or shadow), to produce deep concavities which were related by graceful contours to the structures of either side.

The "Cyma" and "Scotia" curves appear to have been sections taken from the spirals obtained from primary rectangle subdivision, by the principle of continued proportion.

A comparison of "Root 2" — "1.618" — "Root 3," rectangles is shown in Fig. 4. Also a comparison of construction details for a pedestal, designed by using proportions and curvatures (Curve of Force, Cyma and Scotia curves) taken from the corresponding rectangles is given in Fig. 4.

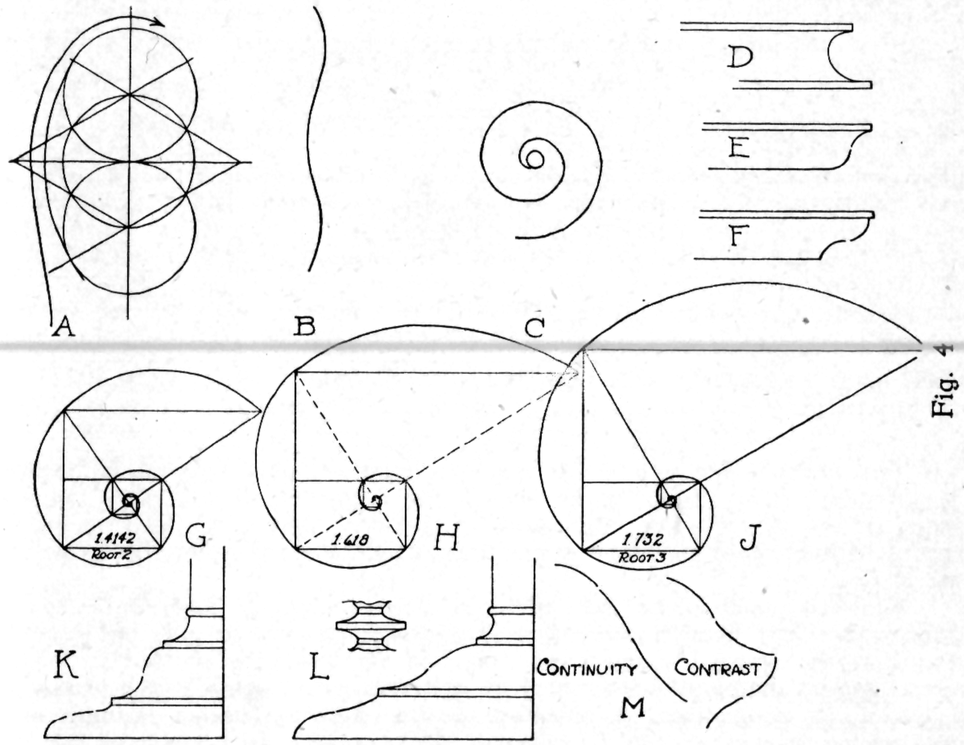


Fig. 4

Appendages

Anything added to the primary mass, to improve the utility of the article must harmonize with the theme of the primary mass. The lay-out of a pattern for a pewter pitcher and the use of the metrical net in the development of a handle is given on page 172. The appendage should be

"Design in Theory and Practice," Ernest A. Batchelder, New York, MacMillan, 1930.
"Art in Everyday Life," Harriet and Vetta Goldstein, MacMillan, New York, 1940.
"A Method for Creative Design," Adolph Mangard Best, New York, Alfred A. Knoff.

unified with the primary mass by echoing or repeating some characteristic of the primary mass. The appearance of something "stuck on" may be avoided by using the principle of "tangential junctions," as observed in natural stem and leaf structures. A base may repeat the lines of the primary mass.

Development of Ornamental Design

The foregoing discussion of the primary rectangle and the principle of the division of space in structural design applies likewise to ornamental design or surface decoration. The basic rules of design: repetition or rhythm, radiation, proportion or measure, balance or symmetry, must be understood and followed. All are suggested or typified in Nature. Repetition is Nature's rhythm, and any simple motif repeated, as in borders, corners, and all-over designs, expresses this principle. Radiation is seen in leaves, flower petals, seed pods and all growth emanating from a central spot or axis. Proportion, or relation of the various parts of a design and expressed by the Greek rules previously mentioned, is most essential as it governs attention and interest. Balance, as in Nature, may be bi-symmetrical, like-sided, as the wings of a bird, or it may be occult, as a tree, which has the appearance of balance though the sides are unlike. Division of space in a design, depending on the position of the design elements in relation to an axis line, gives alternate or diagonal balance as well as bi-symmetrical balance. Styles of all-over designs also depend on balance for variety and emphasis. A study of the illustrated designs will show how these principles are applied and combined.

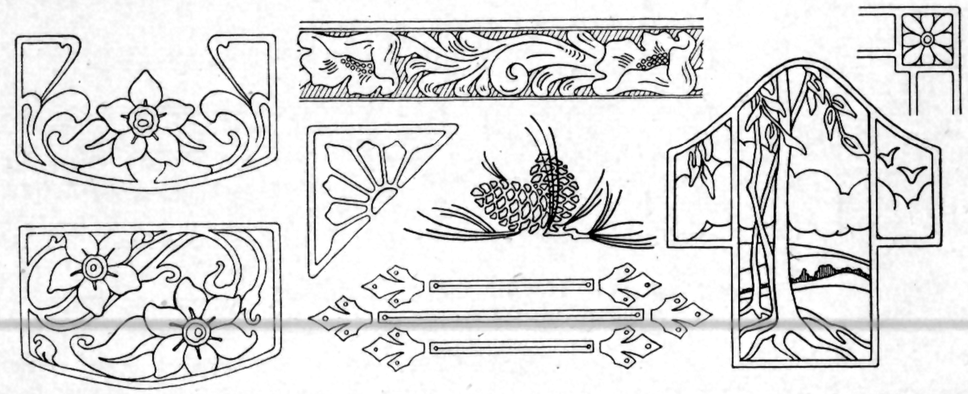


Fig. 6

The purpose for which the article is intended may suggest a suitable design motif. The shape of the area to be decorated may conform to the shape of the article. The boundaries of this area may be defined by reference to center lines or other guide lines which may parallel the shape of the article itself.

Simplicity should be the guide in determining the degree of space utilization. Only enough decoration should be employed to give the impression that the space is adequately occupied. It is also important to avoid overcrowding the space with too much or too intricate detail which produces a feeling of congestion. A pleasing contrast between design outlines and background spaces should be chosen. When these two elements are in balance the foundation for a pleasing decoration is established. The carved decoration used on the coin purse illustrated on page 88, Sketch 22, shows an adaptation of a floral motif to a panel in which the floral detail and the stamped background area are balanced and harmonious contrast results.

In fitting the design motif to the space selected for decoration, it is desirable to test it on an area similar to that on which it is to be applied. Draw to scale, full size if possible, an outline of the area. This will disclose

the relationship of border lines to guide lines on the design. The designs for tooled leather decorations, page 26, have been developed in areas defined by borders which parallel the shape outline.

The carved decoration used on the Brief Case, page 44, is also developed about a vertical center line, and the design area is enclosed by a re-entrant border. There is good balance between the stamped background and the area occupied by the design.

In the application of a pierced decoration on plastics, metal or wood, care must be exercised to preserve the boundaries of the area enclosing the pierced work. This alignment, readily detected by the eye, must be supported without attention being drawn to the points of support.

Little or nothing needs to be done after a decoration has been pierced in thin metal or plastic, except to true up any irregularities in the alignment of borders and make graceful junctions at contact points. In some designs applied to metal, a pierced decoration may require that an engraved line be added to preserve or accentuate detail. A flower stem or the petal would be lost without such a line. See illustration of the pewter napkin clip pierced ornament, page 176. This applies also in etched decorations where an etched line may be too difficult to control.

The foregoing comments on the application of a design will serve to illustrate the consideration which must be given to the limitations of the material, in the planning and in the execution of the decoration.

VISUAL AIDS IN THE HANDICRAFT PROGRAM

Scientific research in the field of photography and the development of projection equipment have contributed new techniques for the presentation of educational material. The miniature camera which uses commercial strip film in black and white, also Kodachrome, the perfected technique for making pictures in color, enable the craftsman and the handicraft instructor to record processes for reproduction in prints or for screen projection, without appreciable loss of detail.

The advance in photographic technique makes this camera a precision tool in the hands of the teacher, craftsman and scientist for the preservation and transfer of skills. It is now possible for them to contribute to the available film slide reference material, a series of "how to do it" visual aids, which will greatly facilitate the presentation and interpretation of the principles and procedures in many kinds of craftwork. This field, heretofore has received little attention in the development of visual aids, because of the difficulty of portraying process sequences with sufficient detail. It should now receive a service comparable to that available in the wide range of filmslide subject matter compiled for historical. geographical and other general information courses.

The standard commercial movie film of 35 mm. width has become the standard width for many miniature cameras. This size of film strip, 35 mm. square, is known as a double frame and is used for both vertical and horizontal pictures. This size film when mounted between cover glass or in a cardboard film mount fits the standard 2"x2" slide holder. Another size picture is produced by using one half of the 35 mm. length or 17 mm. and this is known as the single frame film strip. This size is used when a film strip is to be made at the lowest film cost. It requries a smaller projector for screen showing than the double film strip.

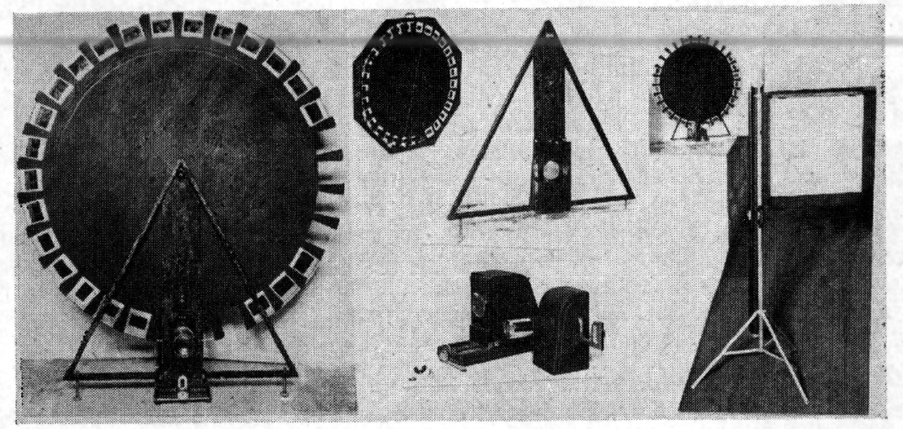
Slide projection is growing in popularity due to the contribution made by the perfection of the Kodachrome. Although the colored film as yet must be sent to the laboratory of the maker for processing, it is returned as separate slides mounted between cardboards 2″x2″ for screen projection. This has become the standard size for slide projection. For any continued use the slides should be remounted between glass for protection and preservation.

Present day projection equipment includes a manually operated slide holder which permits the loading of the next slide while one is being projected. The problem of repeat handling of each slide has been overcome somewhat by the development of an automatic slide changer. This device will handle a number of slides, stacked in a vertical position, show each and return it to a stack arranged in the same relative position, ready for the next repeat projection. In this device slide sequence is preserved, but reference to a particular slide in a series necessitates the projection of the preceding slides or its removal from the slide stack.

This matter of reference to any slide in a series at will is not so important in subjects of general information. However, in a handicraft class where the what and the how of a technique is being studied, reference to any frame in a film strip or slide series is desirable. An attachment which will permit such ready selection of any slide in a sequence has been developed by the author for use on the standard projection equipment. It will permit the projection of single frame as well as double frame strip films, also slides mounted either between cardboard covers or cover glasses.

THE DISC SLIDE HOLDER

In the photograph is shown a disc slide holder* (capacity thirty 2″x2″ slides), developed by the author, also an attachment for its use in connection with any one of several standard make projectors.

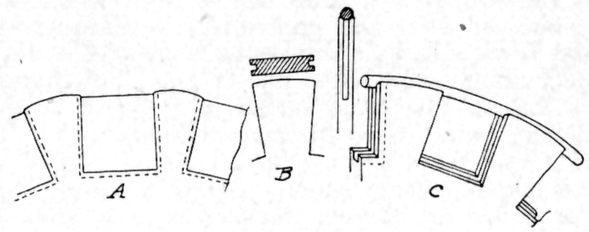


The disc illustrated is made of ¼″ plywood. The slides are set into grooved slots cut in the rim of the disc and held in position by a helical coiled spring or a round elastic. (The rim is coated with shellac before cutting the slots. This prevents splitting of the edge.)

*Patent pending.

This manually operated disc may easily be constructed in any shop having a power jig saw and a drill press. The least expensive grade of plywood is adequate and may be painted or stained black, then lacquered, to match the projector.

A disc carrying case which will hold 6 to 10 discs may be built as detailed in the sketch.



The objective lens and slide holder mechanism is removed from the standard projector frame and placed in a tube attached to the A frame which provides support for the disc. The A frame is attached to the projector base with a thumb screw.

The lamp housing of the standard projector, including the lamp, reflector, condenser and heat absorbing device are left untouched. The disc containing 30 slides is placed on the axle mounted on the A frame and held in the correct position for the projection of each slide as the disc is rotated by hand. It may be rotated in either direction.

This disc slide holder has much merit to reccommend its use in the field of visual education, particularly as applied to the teaching of craft subjects.

1. The subject matter may be presented in sequence and reference may be made to any preceding slide by rotating the disc.

2. The disc serves as a storage receptacle for the slides and may be filed in the library or stock room in an accessible vertical position.

3. It makes possible the handling of illustrated subject matter in units of thirty instead of singly, and a disc may be placed in the projector as readily as inserting a single slide holder.

4. A process may be studied in the shop under day light condition by projection through a translucent screen, as well as shown in a darkened auditorium.

5. It can be operated independently by a student at the work bench and will thereby answer many routine questions ordinarily asked the teacher, decreasing the period of consultation and releasing the teacher for the work of planning and supervision.

Certain procedures and techniques require that a single slide be left in the light beam for several minutes, especially when tool manipulation or an assembly is being studied. The film deterioration due to the heat of the concentrated light beam is overcome by the use of a low wattage lamp (50 to 100 watts), ventilating louvres or even forced ventilation, and heat absorbent glass. These devices have reduced the hazard of film deterioration to a minimum and permit the projection of a single slide for periods of 10 to 15 minutes without danger of injury due to overheating.

Leather is classified in two ways, first by the name of the animal from which it is taken, and, second by the kind of tanning process to which it is subjected. A brief description of the domestic animal skins commercially used may be of interest.

Steer and cowhide are heavy coarse grained skins, used mostly for straps, cases and luggage. Many varieties of leather are also made from cowhide, besides the stiff, heavy strap leather with which we are familiar. In the original state, or after the preliminary tanning processes, cowhide is very thick and heavy, and in this state is finished mainly for saddles, harness, machine belting, shoe soles, etc. It may, however, be thinned or split into several layers. The grain surface is polished or glazed and used for belting, traveling bags, cases of various kinds, or, in lighter weights finished in a wide variety of grain effects in imitations of other skins for book binding and manufacturing many different articles. The sections split off are finished or buffed in different thicknesses or weights, dyed and used for slipper and moccasin soles, shoe linings, the palms of work gloves and the like. Selected splits are given a soft finish and are known as suede or velvet splits. These are used for bags and garments instead of sheep suede, as they are stronger and more durable.

Calfskins are fine grained, light weight and close textured, and are used more widely than any other leather for shoe uppers, purses, bags, book bindings, and art leather work. They are dyed many colors and finished in grains to imitate every other kind of animal or reptile skin. Beautiful cloth like effects and designs are secured by embossing, which is a process of running the skin between rollers with the design engraved on the upper roller which is steam heated.

Sheep skins are porous and open textured. They are finished mostly by buffing on the flesh side and are known as velvet or ooze sheep. Skivers are made of sheep skin using the grain surface, and from this also is made imitation Moroccos and the cheaper embossed leathers.

Goat skins are mostly imported from the Alpine countries or Ural Mountains. This is the toughest and tightest grained skin known, the texture being the result of the cold endured by the animal, or developed as a natural protection from icy winds. The Morocco leathers, highly prized by the early book binders and leather craftsmen of the 16th century were made from goat skins, and this is the leather used by the modern Spanish and Italian leather workers for the finest quality hand tooled and embossed articles.

Leathers are also classified by the three kinds of tanning methods used; chemical or chrome tanned, bark or vegetable tanned, and chamois or oil tanned.

As a factual and fascinating reference, for further information we highly recommend "The Romance of Leather and Its Importance to Mankind," a booklet distributed as an educational service by the National Association of Tanners of the United States.

In addition to a detailed history of the development of commercial and craftwork leather, a discussion of all types of modern leather, geographical sources and the processes of manufacture, is contained in this booklet available for 5 cents per copy from the Tanners Council of America, 100 Gold Street, New York City.

Early Egyptian records give us first knowledge of the use of leather as clothing, furniture ornamentation, shields, and coverings for ships. From the Hebrew Talmud we learn that the Babylonians knew how to make leather, and the legend of the founding of Carthage has preserved the tradition that Queen Dido when promised land that could be covered by a bull's hide, cut it into a thin strip and encircled the land on which the city was built.

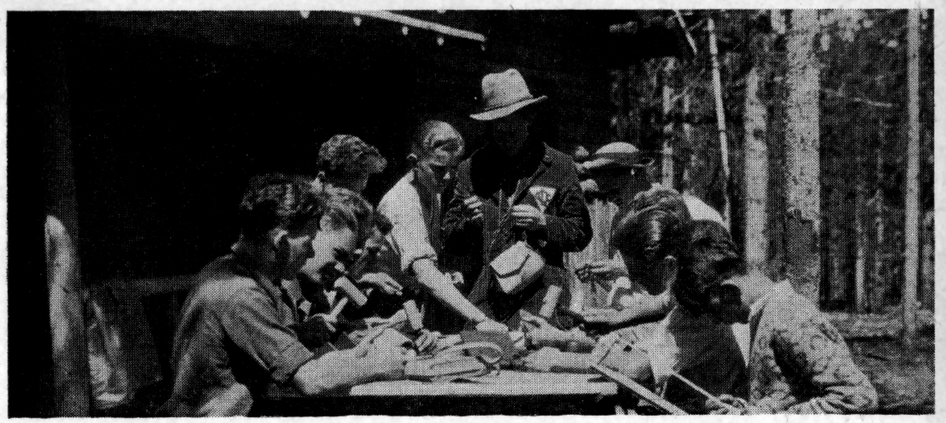
Homer's Iliad describes a tanning process in which the skin after being thoroughly washed is softened with oil beaten and rubbed into the stretched hide. The essential procedure in this primitive process is still used with modern machinery and is called "Shamoying." The Romans also learned how to tan hides with barks and roots and the word tan comes from the Latin "tanare" meaning "oak bark." Another modern word which seems far removed from leather is "pecuniary" which came from "pecus" or hide and refers to the fact that leather was once used as money by the Romans.

In the Roman period the leather tanners and workers were slaves but in the middle Ages they formed one of the strongest guilds.

In Colonial days when many of the Guild craftsmen came to America, they were surprised to find that the Indians were already well versed in the art of tanning. Theirs was a third method of tanning and it has never been determined whence this knowledge came. The process which the Indian still uses and which manufacturers have adopted with little modification except in equipment is called "Buckskin or Indian Tan." The primitive red man, or rather his squaw, loosened the hair with a solution of wood ashes, scraped the hide with a section of sharpened bone to remove both the hair and all flesh tissue and then rubbed into it a mixture made from the liver and brains of the animal. Finally it was hung for days in a small tepee constructed over a fire made of rotten wood so that it would be thoroughly impregnated with smoke which would keep it soft and pliable after wetting.

The first shoes made in America, other than moccasins constructed in the Indian manner, were made in 1628 from hides brought from England by the Plymouth Company, which also brought two shoemakers for this special task. In America, as in England, the crude tanning methods of the Hebrews continued to be used until about 1800 when other sources of tanning than oak bark were discovered, and a chemical process was developed which used chromium salts and resulted in a product more satisfactory for many purposes. Machinery was perfected to take the place of hand labor in the tanning processes and another machine was invented to split the heavy cowhide into several thicknesses, each of which could be utilized, in contrast to the old method of shaving the leather to the proper thickness, a process which wasted a large portion.

Today the finest leathers in the world are made in America from hides which come from all parts of the Western Hemisphere and to some extent from Europe, Australia, Africa and China. The materials now used in tanning are collected from many countries and the importation of vegetable extracts and chemicals for the tanning industry has become an important foreign trade.



Handicraft Group, Camp Chief Ouray
Denver YMCA Camp, Granby, Colorado

Tooling Leather. The leather first developed for fine craftwork, particularly for the highly decorated bookbindings of the previous Century, was a calfskin known as Russia Calf, so called because it was said to have been first produced in Russia by a vegetable tanning process, using white birch bark, from which is retained a characteristic odor. During this Century the tanning industry in this country has developed a bark or vegetable tanned calfskin which is fully as satisfactory for fine tooling as the imported, and the term "Russia Calf" is still widely applied to this leather, both for the natural and for dyed calfskin. In the tanning industry, however, natural, undyed leathers are classed as "Russet."

Only vegetable tanned leathers are satisfactory for tooling, as the surface is firm, yet soft, absorbs water readily, and will retain a crease or a design indefinitely. The chemical, or chrome commercial tanned leather, such as is used for shoes, is partially or entirely waterproof, and the grain surface will not "take" or retain a design.

Tooling calfskin has a smooth, soft surface, which is easily decorated by any of the methods which will be described. It must be handled carefully during the process to avoid tool or finger nail scratches. Spanish or Mission Steerhide is a vegetable tanned leathed of firmer texture than calfskin, and more durable. It is somewhat more difficult to tool, but the finished product will retain its beauty almost indefinitely. It has a characteristic grained or boarded surface and is available in the natural russet and in a variety of two-toned and shaded effects. The famous "Cordova" bags were made of this steerhide. The difference in surface texture of calfskin and steerhide is shown in the illustrations, project section, pages 62 to 75.

LEATHER CRAFTWORK

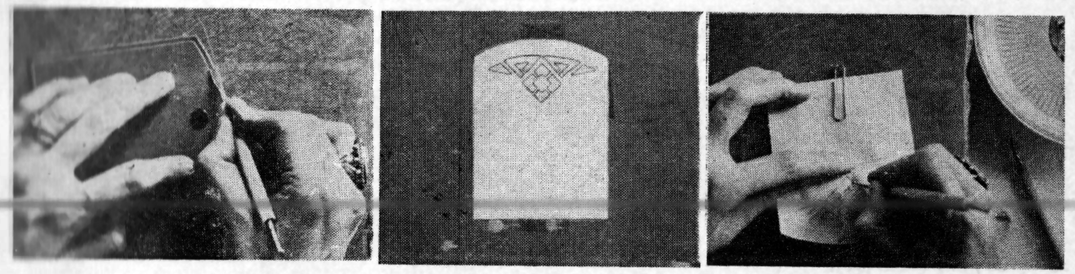
Decoration of Tooling Leather

Procedure In Decorating Tooling Calf and Steerhide,

1. **Tool Requirements** for leather tooling or modeling are: piece of smooth marble or plate glass, single or combination tracer and edge creaser, hardwood creaser, set of modeling tools which include the spoon and deer foot ends, and if a stamped background is planned, a stippler or cross hatched stamping tool. Suitable designs sketched or printed on light weight bond, or tracing paper should be selected, and the paper cut the exact size of the piece of leather to be decorated. A clean sponge for moistening the leather is also needed.

2. **Preparation of the Leather.** Moisten the leather only sufficiently to make it pliable. Rub or pat the damp sponge over the flesh side first, then go lightly over the grain surface until the color darkens uniformly. Let it stand a few minutes until the moisture is distributed, while testing tools and condition of the leather on a scrap piece similarly moistened. Do not have the leather wet enough for any moisture to ooze out when the tool is applied.

It is essential that the leather be re-moistened occasionally as the modeling progresses and it must have entirely dried before any assembly work is done.



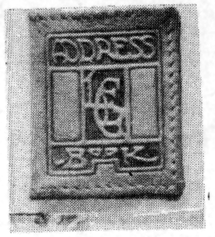
A B C

3. **Edge Creasing and Transfer of Design.** The creasing operation is indicated in illustration A as applied to the edges of the back and flap of an unlined coin purse. This should be done before the design is transferred as the creased marginal line affords a guide for correct placing of the design. The illustration C shows the position of hands and tracing tool. If a paper clip is used to hold the tracing paper in place, do not put any pressure upon it as a mark will be made on the leather. Go over the entire design with the tracer tip of the modeling tool, using a uniform, continuous stroke, and holding the tip at an angle which will not tear the paper. Remove the paper and go over the lines carefully, retracing until a bold impression is obtained. The tools illustrated are combination deer foot creaser in A, and spoon tracer in C.

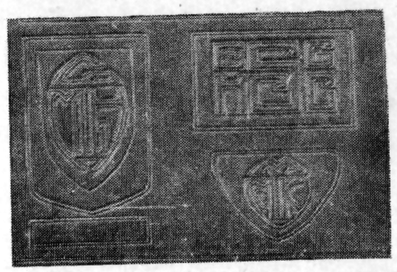
4. Modeling or Tooling of a Design on leather may be applied in several different ways, which will be illustrated and described.

a. **A Design in Outline,** cut A, is the simplest form of leather decoration, and is merely the deeply creased outline of the design with all detail uniformly and clearely defined. All lines are smoothly burnished with the tracing tool or the single end of the wood creaser, which is especially effective in the development of straight line or geometric designs.

A



C



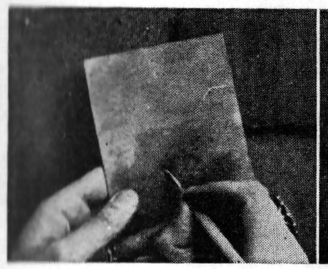
G

b. **Flat Modeling.** A design may be emphasized or given the effect of relief by slightly rounding off or beveling the adjacent area. See designs page 62. As illustrated in C, the entire background in some designs may be depressed and smoothed by rubbing the surface with the flat broad spoon shaped end of the modeling tool D, or in smaller areas with the deer foot tool which is also useful for beveling narrow margins E. The outline should be redefined with the tip of a tracing tool as shown in illustration F.

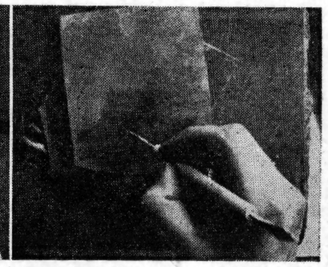
D E F

c. **A Double Bevel Outline,** cut G, which has the appearance of a raised line as illustrated, is an effective method of tooling many designs. After the original design outline has been traced, re-defined and deepened as for simple outline, a second line is traced about 1/32 to 1/16 inch outside, then deepened. The process requires a steady hand and the ability to gauge the spacing of the second line by sight, a skill which may be readily acquired with practice. On the straight lines, a thin celluloid ruler may be used, but the experienced leather craftsman can achieve the double or shadow line effect by sight. After the second line is defined, both lines are slightly beveled. A small deer foot tool is best for this work and the leather must be moist. The inside margin of the first line is beveled, then the outside margin of the second.

d. **Relief Modeling,** sometimes called embossing, is the process of raising the leather in portions of the design. After the design is traced as before described, the impression is usually sufficiently distinct to be followed on the flesh side. In some designs it may be necessary to place a piece of carbon paper, with sensitized surface against the leather, underneath, before tracing the design as usual on the grain surface. The piece of leather is held as shown in E-1 so that pressure may be exerted on the portion which is to be raised, or it may be placed, grain surface down, on a piece of double corrugated cardboard, which will yield slightly without breaking, cut E-2. The deer foot modeler or a tool with a round ball end is used to depress the leather on the flesh side so that it will appear raised on the grain surface. When the degree of elevation seems sufficient, the leather is placed right side up on the marble or glass, and the outline re-defined, as it may have been slightly stretched during the process. It is sometimes necessary to repeat these steps until the desired appearance is secured.

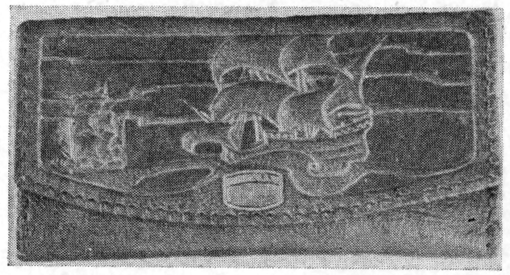


E-1



E-2

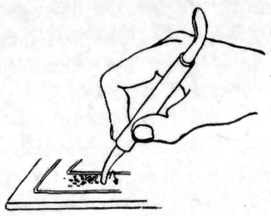
Cuts H and J show a small relief modeled design, with depressed portion on the flesh side and the corresponding raised or relief effect on the grain surface. Illustrated below are adaptations of a ship design in which the sails are relief modeled.



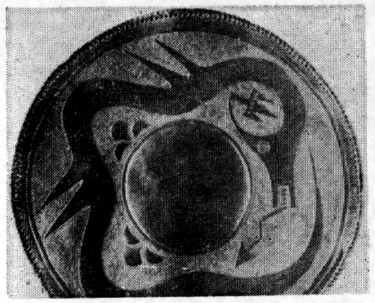
The raised or relief appearance may be permanently retained in several ways. If the leather is assembled over a metal form or cardboard, a piece of cotton shaped to fit the depression may be cemented to the flesh side. The elevation may also be preserved by filling it with a plastic clay which will harden into the desired shape, and a simple method is to use successive layers of gummed tape. A lining is necessary with any of these methods.

Decoration of Tooling Leather

F



F1



F2

e. **A Stamped or Stippled Background** may be applied for contrast in design elements, and is especially effective when monograms, initials or insignia are used for decoration. An example is illustrated in F, which shows the appearance of a stippled background produced by tapping the leather lightly with the end of the tracing tool. A cross hatched or stippled stamping tool, similar to that used in chased metal work, is also used for depressed background areas as shown in F2. It is hammered lightly with a wooden mallet.

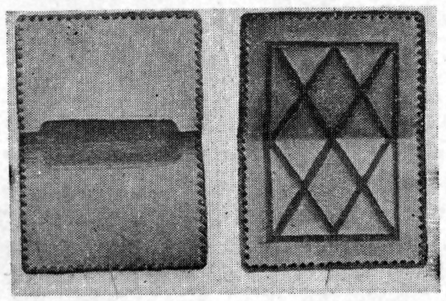
Color Application

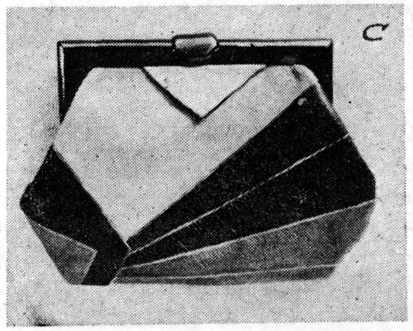
Color may be applied to design areas to emphasize the outline, also to produce added contrast and shaded effects.

Liquid dye or a wash of water color paint may be applied to design or background area with a soft camel's hair brush. Permit each application to dry before successive ones are made. For large surface areas, apply the color in successive applications with a sponge or cheese cloth pad. Experiment with scrap pieces of leather till desired shade is obtained. Polish when dry with a soft flannel cloth.

Effective decoration may be prcduced by means of creased lines, with color applications as shown in the card case illustrated.

A fine liner or pointed brush should be used, and a good leather dye which may be applied without spreading.

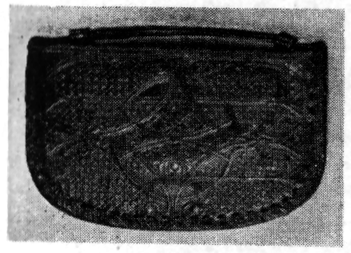




Gold Tooling and Gilding of Leather

The art of impressing gold on leather developed as a part of the bookbinder's craft, but its origin has not yet been traced. It is said to have been employed in Syria as early as the 13th Century and we know that it was brought from the East into Italy after the fall of Constantinople in 1453. For about 100 years Italian craftsmen controlled the art and many examples of their excellent workmanship are still preserved in museum collections. A characteristic of the Italian gold tooling was the wide variety of decoration obtained with a few simple design elements skillfully arranged in combination and repetition. This is evident in the modern Florentine leather craft which is still one of the famous art-craft products of the ancient city of Florence.

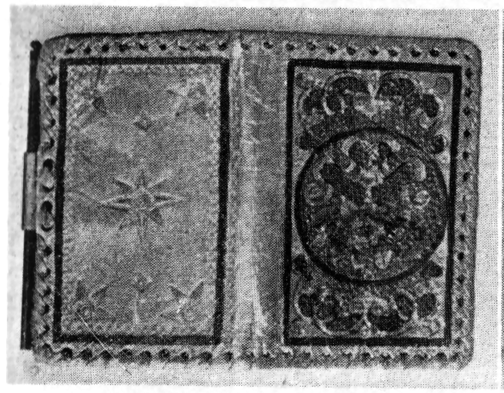
Gold may be applied to leather in two ways. Gold Tooling refers to the application of gold leaf or powder to the design which has been stamped into the leather. Gilding may be done to emphasize the design, to form a background for color application, or to finish the entire surface of the project. Gold leaf or gold powder is used according to the amount of surface to be covered.



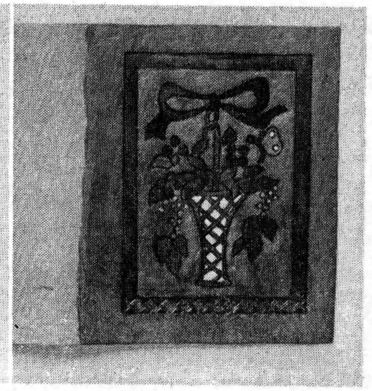
1

1A

The illustration shows (1) a Florentine stamped purse with antique color application to the design area. The purse 1A is a modified Florentine design which is applied by tooling and outlined with a wash of oil paint.



1



2

No. 1 is a Florentine address book covered with gold leaf. It also shows the outline and color application described on page 40. No. 2 shows the front of a book cover with design tooled, gold powder and color lacquer applied and a section of the design border stamped.

Application of Gold Leaf

Tools: Modeling Tools, Background Stamps, Wood Mallet, Gold Size, Brush, Cloth.

Materials: Leather cut to shape, Undyed Calf, Steer or Goat. A book of Gold Leaf (25 sheets), Gold Size, Lacquer, Turpentine.

Instruction:

1. Transfer and tool the design as described on page 34, leaving the stamped background until the gold leaf has been applied.

2. Apply a thin coat of gold size to the leather with a soft brush and permit it to dry. Inspect the thickness of the coat for uniformity and apply additional size where necessary.

3. Apply a second coat of the size and permit this to become partially dry. In 20 to 30 minutes the partially dried size should be "tacky" or sticky rather than wet. The period of drying can only be determined by testing as atmospheric conditions affect the rate of evaporation. Ascertain the degree of stickiness by touching lightly with the finger tips.

4. Remove a sheet of waxed tissue paper which carries the gold leaf from the book. If necessary cut it into sizes convenient for handling. Apply the sheet, gold side down to the leather, covering the sized area in this manner. Press the sheet into contact with the size using a pad made of soft cloth free from lint. Lift the waxed paper gently from the leather, inspect the surface for any uncovered portions, and apply more gold leaf if required. Permit the size to dry, and remove excess with a soft brush or cloth.

5. Apply the stamped background, page 45, and coat with transparent or colored lacquer.

Portions of a design, panels, flower centers and impressions of single stamps may be gilded as outlined in the foregoing paragraph. The gold adhering to other sections of the design is removed by rubbing with a cloth moistened in turpentine.

APPLICATION OF GOLD AND BRONZE POWDER

Tools: Modeling Tools, Background Stamps, Wood Mallet, Gold Size Brush. Cloth.

Materials: A piece of leather of the required size, Undyed Calf, Steer or Goat. Gold Bronze Powder, Gold Size Lacquer, Turpentine.

Instruction:

1. Transfer and tool the design as described on page 34, leaving the background stamping until the gold has been applied.

2. Apply a thin coat of the size to the leather and permit it to dry. This should penetrate the surface evenly without leaving a film.

3. Apply a second coat and permit this to become partially dry and "tacky," see instructions, page 40.

4. Dust the powder lightly over the sized surface and permit it to dry for 30 minutes. Then rub gently over the entire area with a cloth dipped in the powder. Permit the size to become thoroughly dry.

5. Remove excess powder with a cloth dampened in turpentine.

This procedure is followed in gilding thongs for edge lacings. After the thongs have been laced into the edges of the leather, apply a coating of the gold powder and lacquer.

BRUSH WORK DECORATION AND COLORING OF GILDED LEATHER

Tools: Lacquer and Varnish Brushes, Ball Point Pen, Outline Brush, Colored and Transparent Lacquers, White Transparent Varnish, Black Dye.

Instruction:

1. Trace the design lightly upon the leather.
2. Gild by either method described and permit the surfaces to dry. Apply background or other stamped ornamentation.
3. Outline the design with black dye applied with the brush or ball point pen.
4. When the outline is dry, coat the portions of the design which are not to be colored with transparent white varnish. Permit this to dry.
5. Appiy colored lacquers. Yellow lacquer applied to portions of the design as an undercoat may be shaded to green by the application of blue lacquer and red shading may also be added. The red applied directly to the yellow lacquer produces pleasing orange tones. Permit the lacquer to dry.

GOLD TOOLING

Gold Tooling or the application of gold leaf to leather with heated brass type or hand tools is a machine process commercially but may be successfully done by hand, as it was by the bookbinders of the Middle Ages.

Tools: Brass Hand Tools, Tracing Paper, Wood Mallet.

Materials: Gold Leaf, Size, Turpentine, Gasoline, (Oxalic acid solution). A piece of leather of the desired size, cut from Calf, Steer or Goat. The darker shades of dyed leather are best.

Instruction:

1. Transfer the outline design to the leather as previously described, and leave the tracing in position. (Hold with paper clips).
2. Apply cold hand tools. These may be design elements or seals, crests or monograms. The tool is struck lightly with the mallet to impress the design through the paper on the leather. This process is known as blind tooling.
3. Remove the paper and impress the tools on the leather in the same positions as before to deepen the depressions.
4. Wash the surface of the leather with a thin solution of oxalic acid to remove any greasy finger prints and gently pat dry with absorbent cotton.
5. Apply a coat of gold size to each impression and permit to dry until it becomes "tacky."
6. Coat the remaining portion of the leather evenly with vaseline by rubbing a little on with a smooth cloth. This must not come in contact with the design to be gilded.
7. Place a sheet of tissue carrying the gold leaf against the leather gold side down, and press it into the smooth sized areas with the fingers. Apply the cold tools against the tissue to the impressions previously stamped.
8. Heat the brass tools in a sootless flame until they hiss when touched with a damp cloth. Remove the tissue and apply the warm tool with light pressure to the gilded impression for a moment. This sets the size and clearly defines the impression. The operation should be quickly done and care taken to position the tool exactly, so that a clear cut margin will be left. Straight lines are gilded by means of a heated roller which follows the grooves traced on the design.
9. After the leather is entirely dry remove the excess gold with a cloth moistened in turpentine. Remove the turpentine and vaseline with gasoline.

METHODS OF DECORATING LEATHER

Tooling and Gold Stamping—Alternate Method

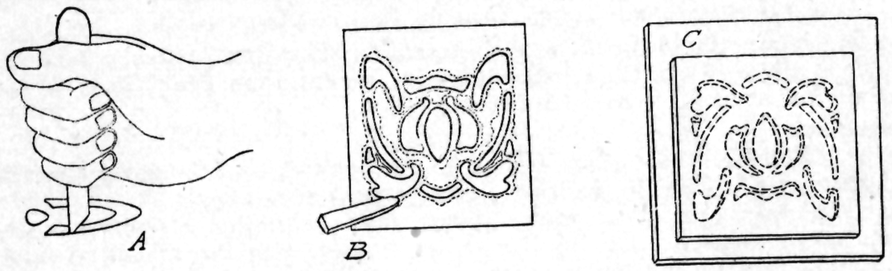
Follow steps 1 to 4 as given on page 39. Dust the surface with gilding powder and apply the gold leaf, preparatory to stamping.

This gilding powder is composed of egg albumen and resin. The heat from the stamping tools applied to the gold leaf penetrates the gilding powder which melts, forming a flux or size at the point of heat application. This insures the gold leaf adhering to the leather only at the desired place. Brush off any surplus gilding powder adhering to the leather.

Underlay.

Areas may be cut out and removed from the leather and an underlay of colored leather attached to the back. The knife should cut through the leather into a piece of soft wood, preferably the end grain, and make a clean incision in the leather. The outer leather with the cutout design complete is placed on a smooth flat surface with the under side upper-most, and the cement is applied around the openings. Care must be taken not to leave any excess glue on the edges, as it will spread into the cutout area and mar the design.

The underlay is placed upon the outer piece, right side down, and smoothed with the hand. Then turn the whole over and press each edge of the design firmly against the underlay. Any surplus cement may be removed later as it begins to harden but before it is entirely dry.



Overlay.

A reverse procedure is used in making overlay or applique decorations. The design area is cut as indicated above but the area removed must be left intact for mounting on the surface of the article to be decorated. Stencil designs may be readily adapted to either underlay or overlay decorations.

Inlay.

Tooled or painted **inlays** of tooling leathers may be applied effectively to non-tooling leathers. Circular, oval or rectangular areas decorated with monograms, emblems or other designs are inset, the corresponding section of the project to be ornamented having been cut out, so that an even surface is preserved. Both must be cemented firmly to a lining after the inlay is in place.

An interesting type of inlay decoration was used by the 16th Century Italian bookbinders. The impression in relief was obtained from dies cut in intaglio. Vellum or rawhide was pressed damp upon the die and left to dry. On removal the cavities were filled with a composition or clay to preserve the shape of the figures. After being transferred to the center of the leather binding they were sometimes richly gilded and painted. It is thought that these medallions were first made from molds which had been made for the purpose of casting plaques for the ornamentation of sword panels.

Similar inlays of rawhide may be adapted to the decoration of leather covered Chests, Cases, Book Ends, Desk Sets, and any article which will have a stiff firm base.

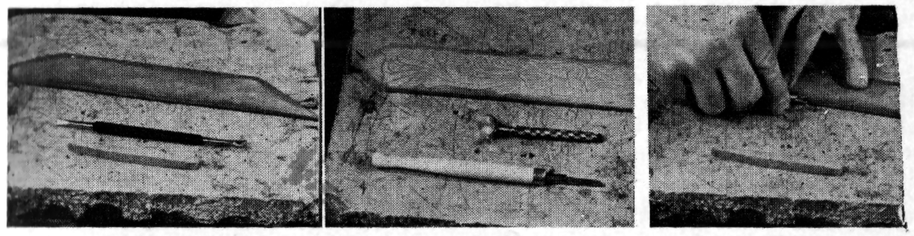
LEATHER CRAFTWORK

Methods of Decorating Leather—Carving

1. **Selection of Suitable Leather** is important. Cowhide or strap is generally used though a grade of veal skin known as kip is satisfactory for some lightweight projects. Both should be vegetable rather than chemical tanned, with the natural grain or hair surface unglazed. This leather is flexible and sufficiently soft to take tool impressions readily. It is available in several weights or thicknesses. Various cases and sheaths can be made of the 4 to 6 ounce weight, but the 7 to 8 ounce is generally more satisfactory for belts, holsters and larger items. The 10 ounce, or saddle skirting weight, is necessary for deeply carved and embossed work.

2. **Preparation of Leather** to be stamped or carved. The piece to be decorated must be uniformly moist, and this is best accomplished by immersion in cold water for about 10 seconds, after which it should be blotted between paper towels or wiped with a soft cloth to remove excess moisture. It should then stand for 2 or 3 minutes covered with the damp cloth before work is started, when the surface color will appear nearly uniform. A slight bending or flexing of the grain surface will hasten the distribution of moisture. In saddle shops where skirting is used for deep carving, it is the practice to soak the leather several minutes in water, then leave over night wrapped in a damp cloth.

3. **Tools Required for Carved Leather** decoration are: Tracing tool, edge beveler, edge creaser, swivel cutter or incising knife, also a modeling tool with spoon and deerfoot ends. A piece of heavy plate glass or marble slab with smooth surface is necessary. A marble slab is used for the example which follows. Illustration shows a combination beveler creaser, also a wood creaser which is especially good for burnishing edges and design lines. The incising knife and swivel cutter are shown with the piece of strap or belt section on which the design to be carved has been traced.



1 2 3

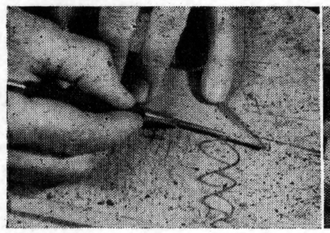
4. **Procedure in Carved Leather Decoration.**

a. Beveling. The sharp edges, both top and bottom, are removed with the beveling tool. A fine continuous shaving is cut by the V shaped end of the double tool illustrated, Fig. 3, which is held at the angle shown. This angle controls the depth of cut and is regulated by the position of the third and fourth fingers which rest on the marble slab and guide the direction of the moving hand in the beveling process. The beveling operation should be completed in one continuous stroke as far as possible in order to avoid any irregularities in cut.

Methods of Decorating Leather—Carving

b. **Creasing.** The beveled edges are then rounded with the creasing tool, held as indicated in Fig. 4. The wood creaser may also be used for this operation, which smooths and rounds the beveled edge and also provides a guide line for the application of the design.

c. **Transfer of Design.** By this time the moisture will have partially evaporated from the surface of the leather, so it should be dampened with a sponge and wiped as before. The tracing paper or section of design sheet is held in place by hand or with paper clips and the design transferred with the tracer, Fig. 5. Equal pressure must be exerted and every portion of the design clearly imprinted on the leather. The process and detail is shown in the illustration and enlargement. The paper is then removed and all lines deepened with the tracing tool tip, Fig. 6.



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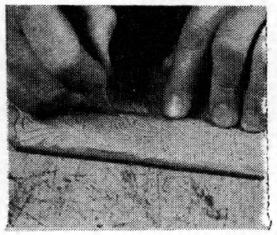

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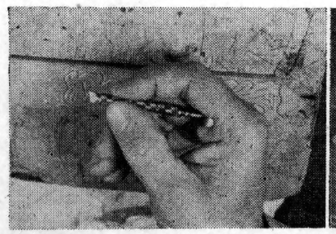
d. **Incising or Carving of Design.** The success of the finished decoration depends on the care and exactness of this operation. The beginner should practice on a piece of scrap leather until position of hand, pressure and depth of cut can be perfectly controlled. The swivel cutter is grasped between the thumb and forefinger with the saddle or top firmly fixed against the forefinger joint, so that the slant of the cutting edge can be guided while the necessary pressure is exerted from the hand, Fig. 7. The direction of cut is preferably toward the worker, and the depth regulated by the angle at which the cutting edge is held. Note that the incising is done with the tip of the tool, while the heel is slightly raised. See Fig. 8 in which the middle and fourth fingers are again used to guide and support the moving hand. The use of the incising knife is shown in Fig. 9. This may be used for the long straight lines. The swivel cutter is more readily controlled in cutting curved design lines. The depth of cut illustrated is approximately 1/32", and is barely through the grain surface of the leather. After the design outline is incised all lines are slightly spread with the tracer to bring the design into clear relief. Care must be taken to avoid blurring of the lines at any point.



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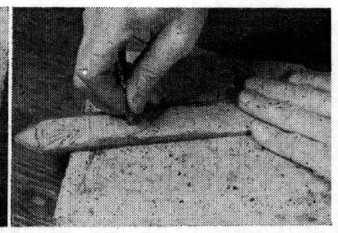

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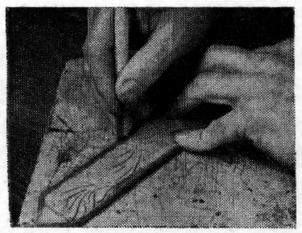

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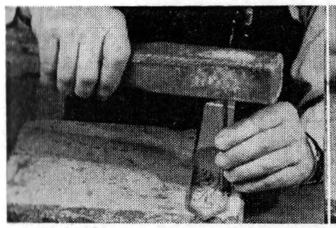
Methods of Decorating Leather—Carving

e. **Stamping of Background.** The background areas are depressed with the background tools. The background tools and impressions are shown in Fig. 13, Nos. 50 and 51. The six dot line tool is first used to depress the marginal area adjacent to the incised design outline as shown in Fig. 10. The round pebble dot tool is then applied to all the background areas, producing an appearance illustrated in Fig. 12 and in the photograph of carved decoration, shown in Fig. 14. During the stamping process the leather may



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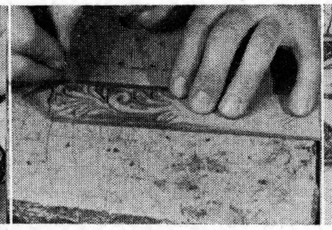

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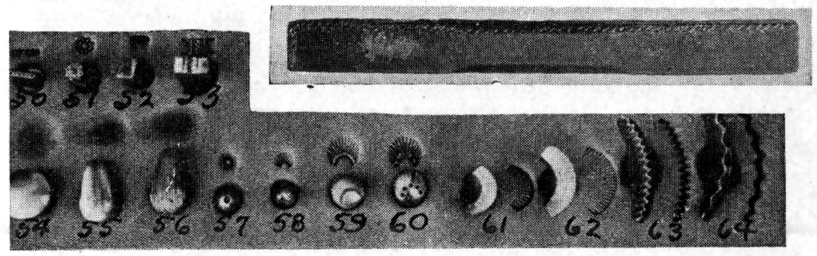
12

require occasional moistening as a uniform impression cannot be obtained on partially dry areas. However, care must be taken not to have the leather too wet or it may be cut and marred by the pressure of the background tools. The hardwood striking stick, which is covered with rawhide, designed to provide the proper balance for regular even weighting of the stroke. It is grasped in the middle as illustrated, Fig. 10. In Fig. 11 the lines are redefined with the tracer.

Background and design tools used in carved leather work are shown in Fig. 13, Nos. 50 to 64.



13

The hardwood striking stick, rawhide covered, is used with saddlers stamps instead of mallet.

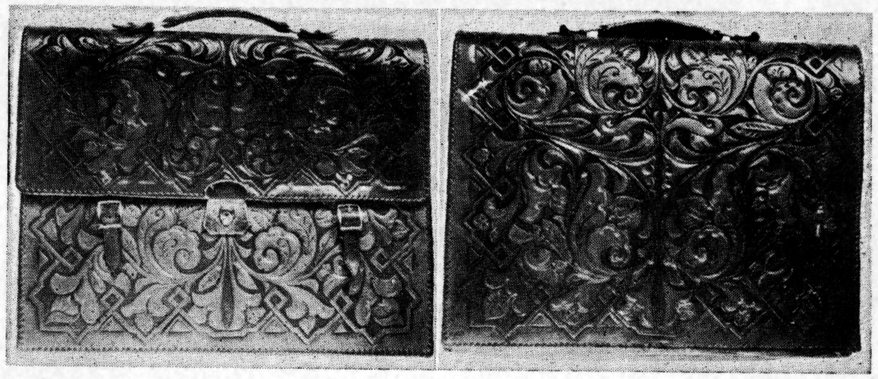
Carved and Stamped Decorations

f. Additional ornamentation may be applied with the veining or scallop shaped tools, Nos. 61-62-63. The oval depression tools, Nos. 54-55-56, are used along the floral outline to give relief to plain areas and to show overlapping. Horseshoe shaped tools, Nos. 58-59-60, are used to emphasize floral elements in section of carved leather work illustrated in Fig. 14.

14

Methods of Decorating Leather—Carving

5. **Finishing.** The design outline should be re-defined with the tracing tool and the incised lines within the design opened and deepened. The deerfoot tip of the modeling tool may be used to round the curved edges and smoothly burnish the edges of the design, also to emphasize elements in the decoration. Care must be taken to leave distinct lines. Contrast and depth, particularly in a floral decoration, is produced by the careful modeling



of the over-lapping elements in the design. On belt edges, also on the edges of articles which are to be assembled by lacing or stitching, the original creased line is restored with the creasing tool. Belt edges are given a deeper color and gloss by the application of "burnishing ink" with a swab applicator. This should cover only the cut edges and not touch the grain surface. Burnishing ink contains wax which seals the cut surface and takes a high polish with rubbing. If desired the background areas may be darkened with oil or stain.

6. Transfer of a repeat motif or other design without the use of tracing paper may be done by imprinting the design, which has been traced and incised on a separate piece of leather, to a belt strap or other leather. Figs. 15 and 16, shows this process. The incised design, Fig. 15, must be entirely dry and the leather to which the transfer is made, moistened as before described. The first piece is laid in position, face down and tapped with a mallet sufficiently, Fig. 16, to make a clear impression, which may then be outlined and deepened with the tracing tool, after which the carving procedure is followed as previously described.

15 16 17

Methods of Decorating Leather—Stamping

The decoration of belt straps, axe and knife sheaths, also camera cases and some other articles, may be done by the application of stamped rosettes, creased lines and various border designs. The leather is not cut as in carving, and the tools or stamps are depressed to a depth sufficient to give a clear and lasting impression. It is effective only when done with accuracy in the spacing and arrangement of the design, and with exact alignment of the impressions stamped along the border lines. When these principles are mastered in practice, and the knack of positioning, holding and striking the tool acquired, the operation of stamping is easily done. As in any form of leather decoration, the beginner should practice each step in the procedure before attempting a project.

1. **Preparation of Leather.** The directions given under carved leather decoration should be followed.

2. **Transfer of Design.** No transfer is necessary as in carving procedure. Guide lines may be indicated and a spacing layout followed according to a plan previously sketched on paper.

3. **The Tools Required** for stamping are: Mallet or hardwood striking stick, pair of dividers, ruler or straight edge, beveler, creaser, piece of marble, and a set of stamping tools.

Fig. 18

4. **Background Tools.** Tools similar to those used in carved leather work, are necessary to depress areas around design motifs or initials as in panel G, Fig. 18. **Border Stamping Tools** of different types are shown, in Fig. 19. The line and edge decorations used on the belt sections illustrated below are applied with the horseshoe and pine tree stamps, which are sketched in B and C, Fig. 18. A star shaped stamp is effective for borders and at the intersection of design lines. The background or **central area stamping tool** which is generally used to decorate panels is called the **basket weave,** and is shown in Fig. 17, page 44. The impressions of the horseshoe, pine tree and basket weave stamps and a photograph of these stamps are shown in Fig. 17.

5. **Procedure in Stamped Leather Decoration.** The process of edge beveling, also edge creasing, is followed in exactly the same manner as described in the method for carved leather decoration. The accuracy of these operations is important as the edge crease is the guide line for the border stamping. See Figs. 4 and 5, page 42.

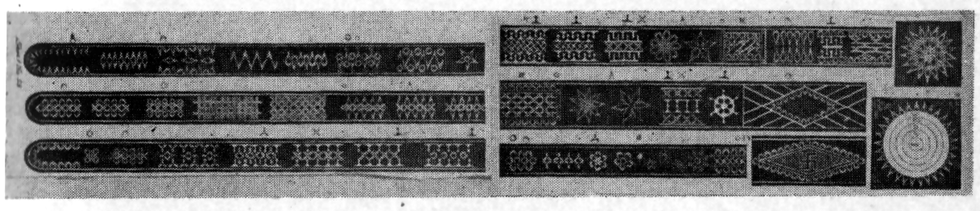


Fig. 19

Methods of Decorating Leather—Stamping

6. **Use of Border and Design Stamping Tools.** As indicated above, the stamping tool is driven into the moistened leather to a depth that will give a clear impression. A wooden mallet is used or a striking stick such as is illustrated in the depression of the background areas in carved leather decoration, Fig. 10, page 43. The pine tree stamp can be used to produce many different rosettes as well as edge and border line decorations. It is also used effectively with the horseshoe stamp. The pine tree is made with an angle of 40 degrees so that nine impressions will exactly fit within a circle, the radius of which is the length of a side of the stamp. The making of these and other stamps is described in the section on tool making which will follow.

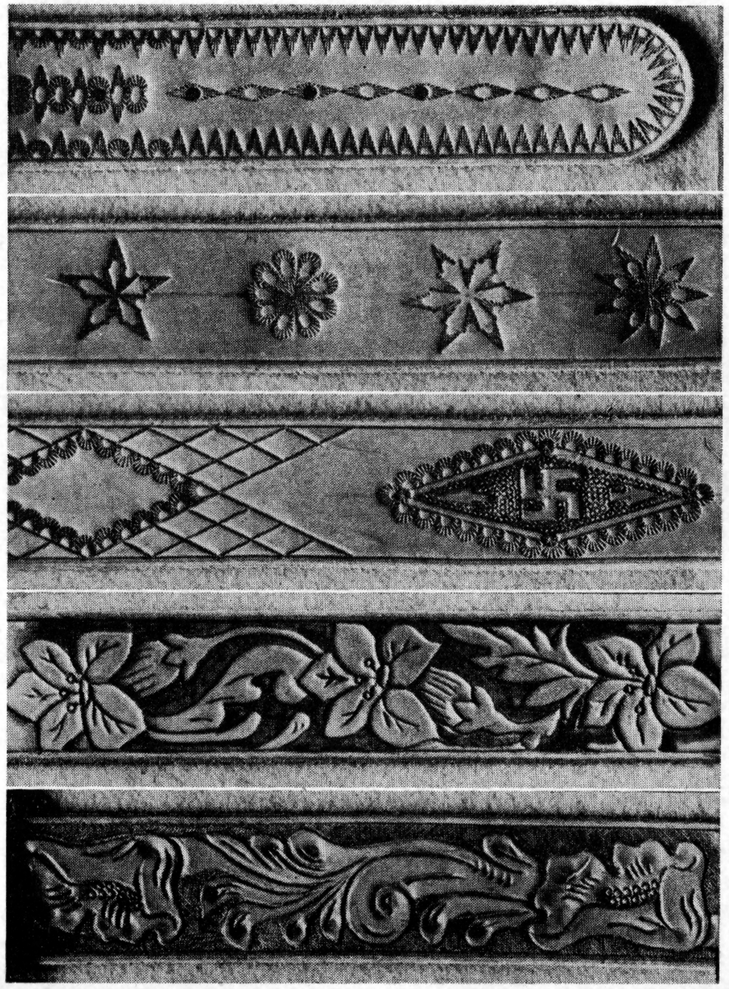


Fig. 20

The basket weave design is applied by placing the stamping tool first at one corner of the panel to be decorated. The next impression should be made on the line above with the lower edge overlapping the upper edge of the first impression, as shown in Fig. 17, page 44. Continue in this manner until the width of the panel has been covered with the impressions and the appearance is that of a stair step design. From this start fill in the other impressions needed, and the finished appearance will be that of a woven pattern which is very effective for covering considerable space.

Methods of Decorating Leather

7. The creased designs illustrated are made with a creaser or tracer. The lines are first lightly marked then deepened by retracing until a lasting impression results. The wood creaser is excellent for this purpose as it produces a darkened, burnished line.

Jeweled and Metal Ornaments

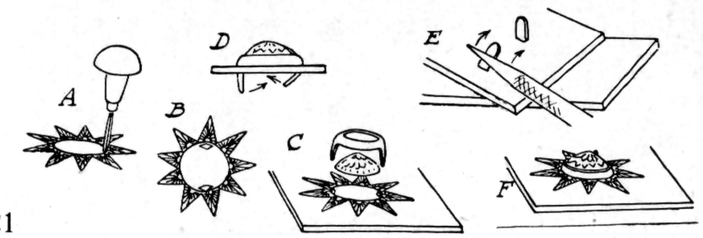


Fig. 21

Another method of decoration is found in the use of brass, nickel, silver, also jeweled ornaments.

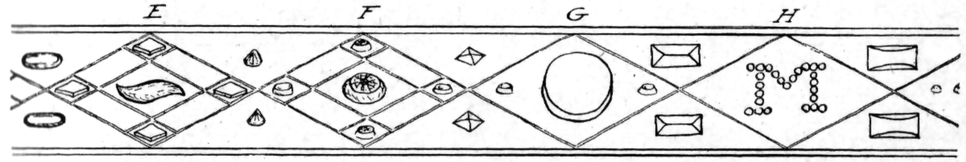


Fig. 22

The method of applying a jeweled ornament to a rosette made with the pine tree stamping tool is illustrated in Sketches A and F. A and B show the awl perforations—C and D the insertion of the metal prongs, and E the bending of the prongs underneath. A variety of metal ornaments is shown in Fig. 22.

Tool Making

The design and construction of leather working tools is in itself a fascinating art. Any one or all of the tools used in tooling or stamping leather may be made by the user who possesses a bench vise, hammer, center punch and a few files of the proper size and shape.

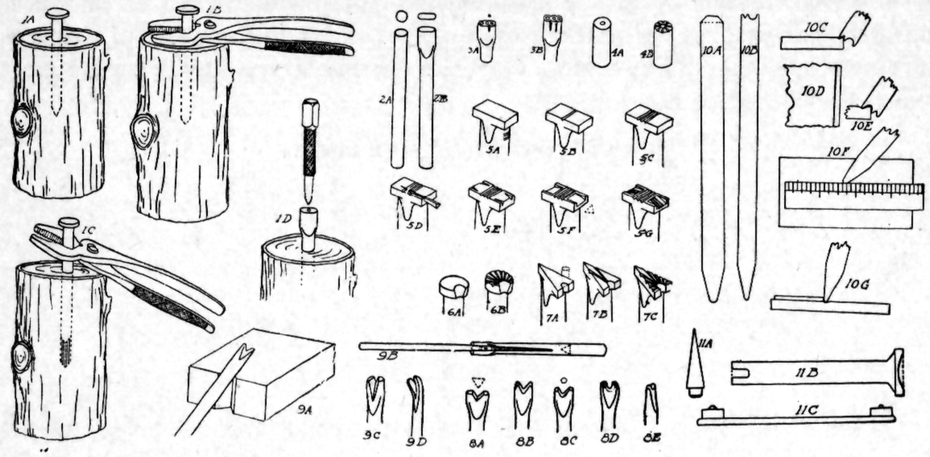
Where bench vises are not obtainable the stamping tools may be made by using a short length of log or piece of firewood, and a pair of pliers. Sketches 1A, 1B and 1C, Fig. 4, indicate the use of a piece of timber to hold the spike from which the stamping tools are made.

Stamping tools may be constructed out of 16 or 20 penny nails, and the designs illustrated have been selected since they may be constructed with comparative ease.

The necessary tools required for making tools of the designs illustrated are a few files, one a 10 or 12 inch bastard and some jewelers' needle files (ask for No. 4 cut, round handle needle files), a rat tail or round file also a square file, and a three sided taper file, called a three square. For making stippled background tools and rosettes a center punch and hammer are also required.

LEATHER CRAFTWORK

Tool Making



1. The first operation is to file the head of the nail with the large file, or shape on an emery wheel, until it is reduced to the approximate shape and desired size.

2. After shaping the nail head, make the reference or base lines, by filing lightly with one edge of the three-sided file. If this line is not in the proper place, smooth off the top of the nail head and try again. As soon as the base line or lines are made, space the other lines or file cuts by sight, judging by the number to be cut and the distance between cuts.

3. Remove wire edges by rounding all corners and edges of the file cuts in the nail. Afterwards cut off the point of the nail, slightly bevel and smooth up the edge to present a flat striking surface for the mallet.

The sketches, series 3, 4, 5, 6 and 7 show the procedure in making up the three dot, star, basket weave, horseshoe and pine tree stamping tools. Sketches 2A and 2B indicate the shape of the nail which has had the head removed, and in 2B it is slightly flattened. The flattened nail is center punch pricked as shown in sketch 1D and finished by filing as indicated in sketches 3A and 3B.

A good beveler may be made from a piece of drill rod or a nut pick and shaped by hammering and filing as shown in sketches 9A to 9D. Fig. 4. It is not necessary to use a vise. Drive the rod from which a beveler or creaser is made into a log to hold it securely. These tools may be shaped by holding them in the hand firmly against a notched block—sketch 9A—attached to the work bench. The rod may thus be tilted so that it can be filed in different positions as shown in 9B. Sketch 9C shows the beveler shape after filing and before it has been tapped with the mallet to give it a slight bend. The bent tool is shown in sketch 9D.

A good Creaser may be made out of a nail by hammering and filing it to shape as indicated by sketches 8A to 8E. Sketch 8A shows a cut with a taper file, 8B shows the edges slightly rounded, 8C shows the rounding out of the V notch, and 8D the appearance of the finished tool, front and side view.

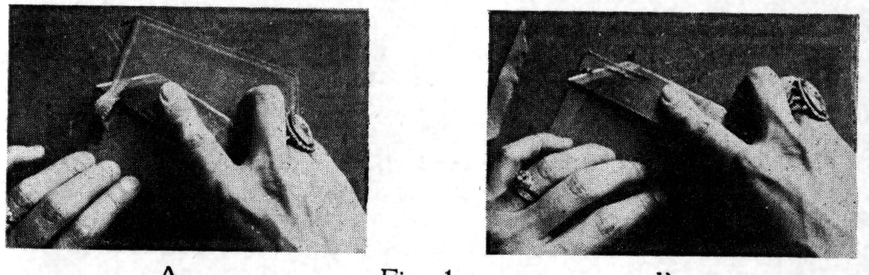
Excellent Tracing Tools may be constructed out of knitting needles, ice picks, nut picks, scratch awls, or any piece of metal having a long taper and a rounded point. Modeling tools may also be constructed out of pieces of tool steel.

LEATHER CRAFTWORK

Assembly Procedure for Tooled Leather

1. Tool Requirements are: Skiving stone or smooth plate glass, skiving knife, flexible leather cement, edge creaser, punch or other tool for perforating the leather edges which are to be laced. A spike or other tool with smooth tapered point is required in lacing.

2. Edge Skiving. In articles where lining is used, it is desirable to reduce the thickness of the edge of both the lining and the outer leather. This gives a neater appearance to stitched and thong-laced edges, and renders a fold less bulky. The method of edge beveling or skiving is illustrated in Cut A. A skiving or leather paring knife is used as indicated. The leather is placed upon a smooth hard surface, skiving stone or plate glass, with the finished surface down. The point of the knife blade rests upon the stone, and this guides it as the cut is made across the edge of the leather. Thin layers of the flesh surface are removed successively until the desired thinness is secured. The edge on the knife must be kept very sharp by stropping frequently on the under surface of a piece of heavy leather.



A Fig. 1 B

Note that the skiving starts near the top of the upper left edge and that the direction of the cut is outward in position A. The piece of leather is rotated until the edges are skived, leaving the corners at the beginning of each stroke. These are skived as shown in Cut B. In skiving an edge which is to be turned back on itself or over a gusset lining, it is desirable to score the leather where the fold is to be made, then remove, with the skiving operation shown in A the section of the surface between the score cut and the margin. Of course care must be taken to avoid cutting through.

Fig. 2 shows the steps in finishing a skived edge of a purse which is not to be lined. The edge is first moistened and the fold creased down. Cement is applied lightly from the fold to the margin and it is then smoothed down in place. The folded edge is creased to produce a neater finish as indicated.

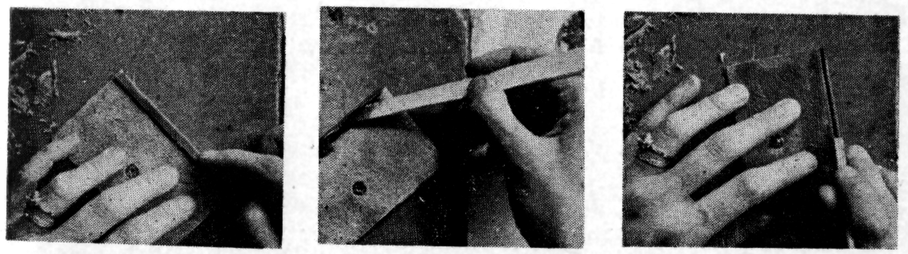


Fig. 2

An Unlined Coin Purse, which has been skived at the edges as described in the preceding paragraph, has the front and back parts cemented in position for punching as indicated in Figure 3. Note that the thickness of the combined parts is about equal to that of the unskived flap. If the edges of the leather are lighter in color than the surface they should be stained before cementing, though this may not be necessary if a style of lacing is used which will entirely conceal them.

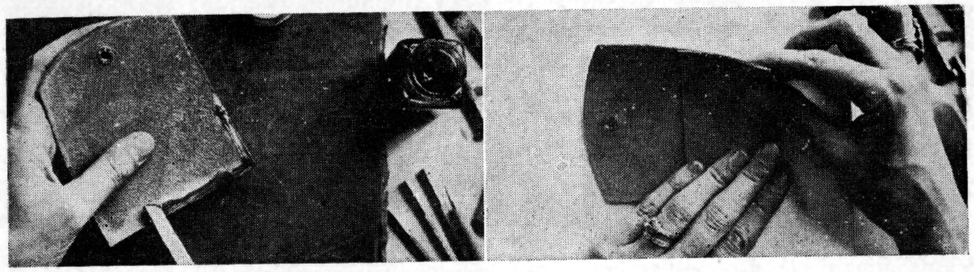


Fig. 3

Selection of Linings and Method of Attachment. Some articles made of calfskin, such as small purses without gussets need not be lined, as the flesh or inner surface of calf is usually buffed to a suede-like finish, also since the entire skin is dip dyed, the color is nearly the same on both surfaces.

Cementing a Lining.

The grain surface of steerhide for tooling is colored by a spray process, and as the skin is leveled or split to the desired thickness, the flesh side is rough and light colored. Articles made of steerhide should be lined, and sheep suede in a harmonizing or contrasting color is usually selected. Other lining leathers suitable for use with steerhide are: skivers (a thin grain surface split from sheep skin), thin goatskin or lining calf. Goatskin is the most durable and especially satisfactory in articles subject to a great deal of wear.

Articles in calf which require lining; bill folds, keytainers, cases, bags and the like, may be lined with the thinner, soft sections of the tooling calfskin, or with lining calf, suede or skivers. Skiver linings are not thinned by skiving but the other lining leathers should be reduced in thickness at the edges as previously described.

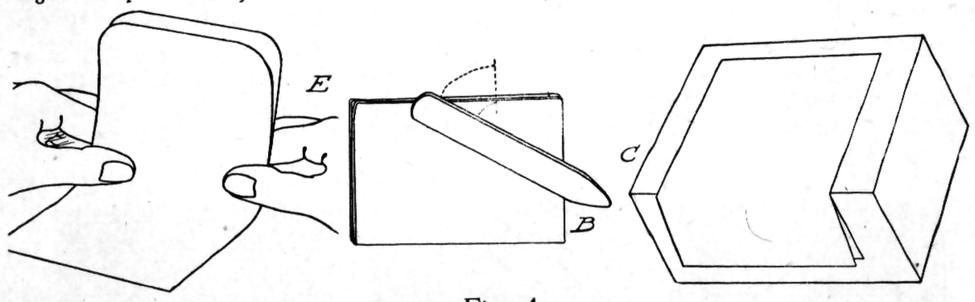
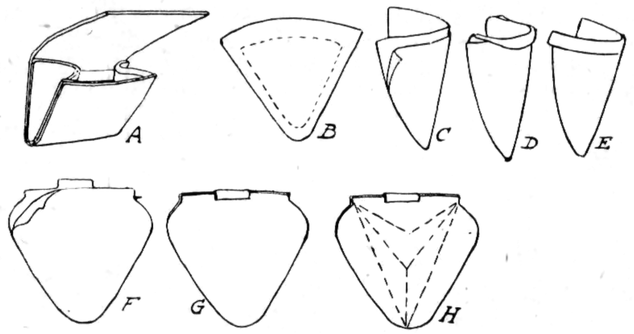


Fig. 4

The procedure in cementing a lining in position is shown in Sketches B and E, Fig. 4. The flat surfaces are first cemented together at one side or end, the cement being applied over two or three inches at a time and the surfaces smoothly attached together before additional cement is applied. With the successive applications of cement, any wrinkles in the lining should be removed by smoothing toward the edges with a bone folder or similar

tool as indicated in Sketch B. In Sketch E, the lining is shown as attached to a folded part, such as the flap of a purse. In order to prevent a wrinkle at the fold, the back portion is first cemented flat, then the cement is applied along the sections to be folded and out to the edges while the pieces are held in the position indicated. Before the cement dries, they should be folded completely forward to the position they will take when the article is assembled, and any wrinkles smoothed out. If the lining and outside pieces are cut the same size it is usually necessary to trim the lining slightly as it is less reduced in length than the outside piece when folded.

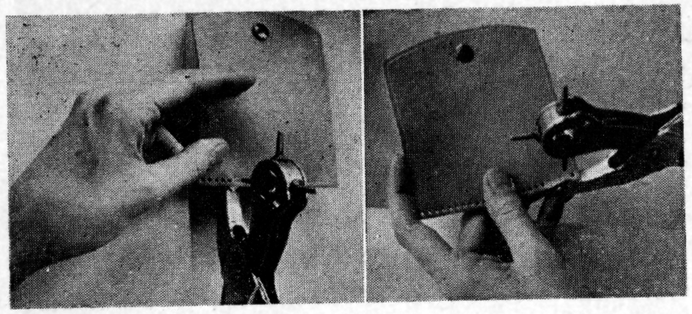
Sketches B, C, D and E indicate the procedure in lining a **gusset,** such as is used in the **envelope bag** illustrated in sketch A. B shows the shape of the outside piece of leather with the edges skived. Note the top is skived back farther from the edge than the other margins. Sketch C shows the shape of the lining which is shorter than the outside piece. The cement is applied to the edges and along the line of the fold, then the lining is placed in position as shown in sketch C, and the whole gusset folded as in sketch D. The edges are then pressed firmly and smoothly together while it is held in the folded position. The top edge of the outer leather, which extends beyond the lining, is then folded over the lining and cemented down, sketch E. The gusset is now ready to be inserted in the proper position in the bag, as indicated in sketch A. The edges of the gusset are cemented to the edges of the outside, to hold them in position while the bag is punched and laced. Care should be taken to cement only the edges together, and the cement should be spread no farther than about ⅛ inch from the margins. Much of the appearance of the bag depends upon this operation. After the edges are firmly cemented, any uneven margins which may have developed in the smoothing and stretching of the lining, should be trimmed before proceeding with the punching. This can best be done by cutting with a sharp knife along a straight edge or metal edged ruler, on a block of wood.



The outside and lining sections F and G for the **gussets of metal top bags** are cut the same except for the two inch lap which is to be turned over the lining at the point of the hinge. The top edge of the outside including the lap must be skived very thin and the lining is cemented in position with both pieces on a flat surface. The fold of the finished gusset takes position shown in sketch H.

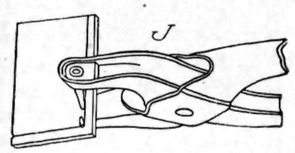
Methods of Perforating Leather for assembly with edge lacing. A leather punch with a hole spacing gauge, and fitted with a suitable tube, is the simplest tool to use. The holes made with a punch permit a more rapid lacing operation than other methods of perforation described below. For narrow lacing, average 3/32" thong width, a double naught, (00), tube

should be selected. Wide lacing thongs, (1/4" or 3/8" widths) used for the style of lacing which is termed Florentine, require a naught (0) or No. 1 size tube, depending on the thickness of the thong. Illustrations A and B show the use of a rotary punch which is fitted with four sizes of tubes which may be rotated to position. Sketch J shows a single tube punch with the spacing gauge tip inserted in the first hole punched in the corner of the leather and touching the creased guide lines. The rotary punch illustrated is also fitted with a gauge tip.



A

B



The marginal space is kept even by following the creased guide line as punching progresses. At a point about ½" to ¾" from the corner, Cut B, the intervening space should be observed, and if necessary, the spacing slightly increased or decreased in order to make the corner hole come in the right position. A good practice is to estimate the spacing and mark lightly the position of the holes, before punching either with, or independently of the gauge. If the anvil becomes rough from use, the under margin of the holes may be marred. To prevent this, smooth the anvil occasionally with a fine file. In any case it is desirable to punch with the outside of an article uppermost. A piece of thin leather or paper held underneath the purse while punching will prevent scratching and save the edge of the tube.

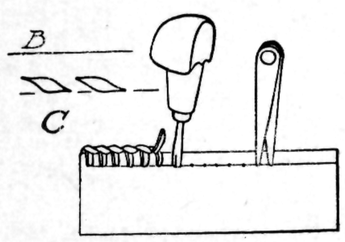


Fig. 5

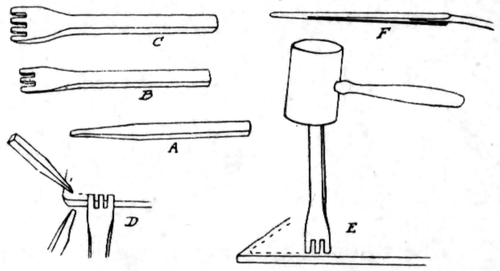


Fig. 6

Sketches B and C, Fig. 5, show the method of perforating the leather for edge lacing, using an awl instead of the punch with the hole spacing gauge. A greater strength is obtained between perforations by placing the awl in the position shown in Sketch B. The hole spacing may be first marked with the dividers as indicated. The holes are punched as the lacing progresses and it may be necessary to spread them with a marlin spike or the end of the tracing tool to receive the end of the lace. Sketches D and E. Fig. 6, show another method of perforating the leather for edge lacing,

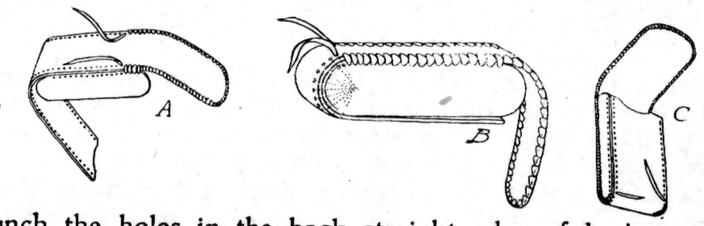
using the thong chisel. The chisels are available with one, three, and four prongs as indicated by Sketches A, B, and C. The single prong chisel is useful for punching corner holes or slits. The three or four prong chisels are used as indicated in Sketches D and E. The hole spacing is controled by placing one prong of the chisel in the last hole punched. Sketch F shows a Thong Lacing Tip or needle which facilitates lacing through the awl or chisel cut perforations. This metal tip is made like a clothes pin.

Punching and Lacing Procedure—Gussets

Camera Cases, and all projects having curved gussets which are to be inserted at right angles should be punched and laced as follows:

1. Punch edge of outside piece and lace the flap, using lay-over or whip stitch.

Fig. 1



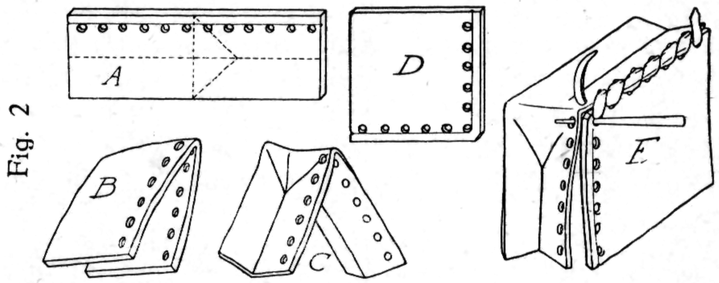
2. Punch the holes in the back straight edge of both gussets, using same spacing as outside. Start lacing gussets in position with thongs for both sides in the same direction as indicated in Sketch A. This is important to insure equal pull on the thongs and correct fit of the gussets. Lace two or three inches alternately on both gussets until the beginning of the bottom curve is reached.

3. Fold outside around the gussets and lay off the holes on radial lines as indicated. Sketch B. Punch the holes as marked and continue lacing the gussets in position.

4. Punch front straight edges of gusset with holes corresponding to the outside as shown in Sketch C and finish lacing. Conceal the ends of the thongs by passing them back under the last three loops. See Sketch 20, page 88, for method.

Envelope Bags, Brief Cases, Portfolios, and other projects requiring straight folded corner gussets are punched and laced as indicated in Fig. 2.

Fig. 2



1. Lace the flap first, using wide lacing. Start the thong through from the underside at the middle point. Pull through to the center of the thong and lace toward the corners. Leave sufficient thong to conceal ends in the gusset lacing later.

2. Locate the center of the gusset strip, punch about four holes, using the same spacing as in the back of the brief case, tie in position and continue punching toward the corners. Compare spacing occasionally as the softer gusset may stretch in punching. Estimate the hole spacing for about one inch from the corners and increase spacing slightly if necessary to make the end hole come exactly in the corner. Fold the gusset and lace as shown in Fig. 2, Sketches A to E.

LEATHER CRAFTWORK

Assembly Procedure

Lacing of Butt Edges

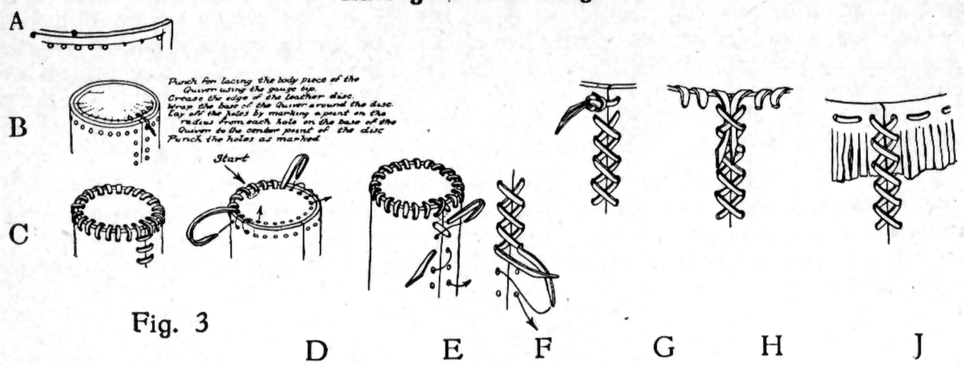


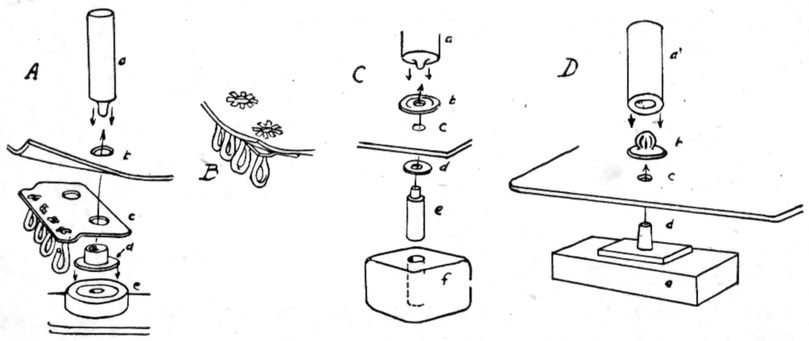
Fig. 3

Quivers, Flash Light and Field Glass Cases, also any circular type case or project requires the punching and lacing of edges which come squarely together, forming a butt joint. The holes should be exactly parallel and a cross type of lacing is easier to keep straight.

1. Punch the bottom of the quiver body, using the gauge, with hole spacing about ¼". Start at one corner and when near the opposite corner estimate the distance and slightly increase the spacing to bring the final hole in the corner. Sketch A shows this, also the method of positioning the holes in the bottom, Sketch B.

2. Punch one hole in the bottom and tie in place through a corner hole in the body. Fold the edge around the bottom and mark off the holes on the radial lines extending from the outside holes to the center of the bottom. Untie and punch as marked. Identify the first hole so that it may be placed in the same position to lace.

3. Start lacing the bottom opposite the corner holes in the body with the ends of a two yard length brought up from the bottom as indicated, Sketch D. Lace the bottom in place until the thong ends come together at the corners of the body, cross these through the corner holes as in Sketch E and continue lacing the sides of the body together with the cross stitch. Sketches E and F show method of adding a new thong as required.



Attachment of Key Plates and Posts

Sketch A indicates method of attaching a key plate to the lining of a keytainer, using an eyelet setting tool. The lining is then cemented and laced to the outside piece. If unlined calf or steerhide is used the eyelets are inserted through the leather first and flattened against the plate.

Sketch C shows the parts of a screw type key post, setting tool and method of attaching.

Sketch D shows attachment of Bag Plate.

LEATHER CRAFTWORK

A Method of Attaching Snap Fasteners

There are four parts to the type of fasteners shown in the sketches. The post and spring are illustrated in sketch F. The eyelet and cap are shown in sketch G. The leather is perforated to receive the post with a drive punch. The tool parts are: the needle, sketch A; setting tool, sketch F and B; and

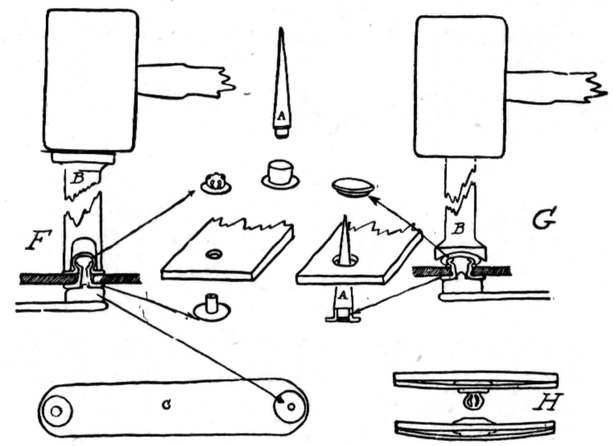


Fig. 8

anvil, sketch C. The small end of the tool fits over the spring while the larger end is used in setting the cap. The procedure in attaching snap fasteners is as follows: (1) Insert the post, see sketch F, in the leather, and place it upon the anvil, with the small tip in the center of the post. (2) Place the spring on top the protruding post as shown in sketch F, and place the setting tool over the spring, strike it lightly with a wooden mallet. (3) To insert the eyelet, place the needle upon the eyelet, see sketch G, and press the leather down over the needle. Remove the needle, and place the eyelet upon the anvil with the large tip in the center of the eyelet. Place the cap upon the protruding edge of the eyelet, cover it with the setting tool and strike it with the wooden mallet.

As a rule the snap fastener should be attached before the purse or bag is stitched or laced. If it is necessary to put on the fastener after the article is completed, lay it upon a smooth surface and insert in the purse a firm heavy piece of leather which will prevent the drive punch from perforating the back of the purse. Leave the leather in the purse as a base for the anvil when putting on the fastener.

Styles of Edge Lacing

Three styles of so-called layover stitch lacing are shown in Sketches 1, 2 and 3, and will be described as single, double and triple, referring to number of loops included in each stitch. The article to be laced is held with the outer or right side away from the worker, the direction of the thong is toward the worker and the procedure is from left to right.

1 2 3

To Start Lacing by any of the methods described, it is necessary to take one whip stitch to anchor the end of the thong as lacing continues. About two inches of length should be left for concealment between lining and outside or beneath the stitches which follow. This finish would be sufficient at the end of a gusset.

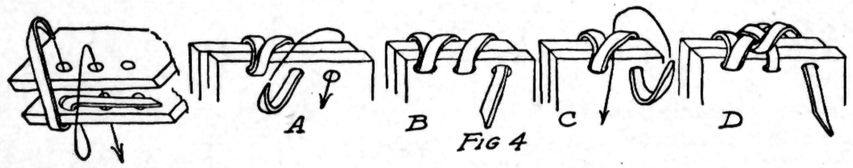


Fig 4

1. Single Layover is similar to the button hole stitch used in sewing and the thong is laid back over itself after each loop through the hole or slit in the leather. Procedure is sketched to show detail in Fig. 4, the arrows indicating direction of thong. Fig. 5 shows the appearance of the lacing as it is tightened and continued. Sketch E shows the right or outside of single layover lacing. Note that the thong stitches are vertical or at right angles to the edges of the leather on the outside, while on the inner side they necessarily slope. A thong approximately 4½ times the length of the edge to be laced is required for single layover stitch.

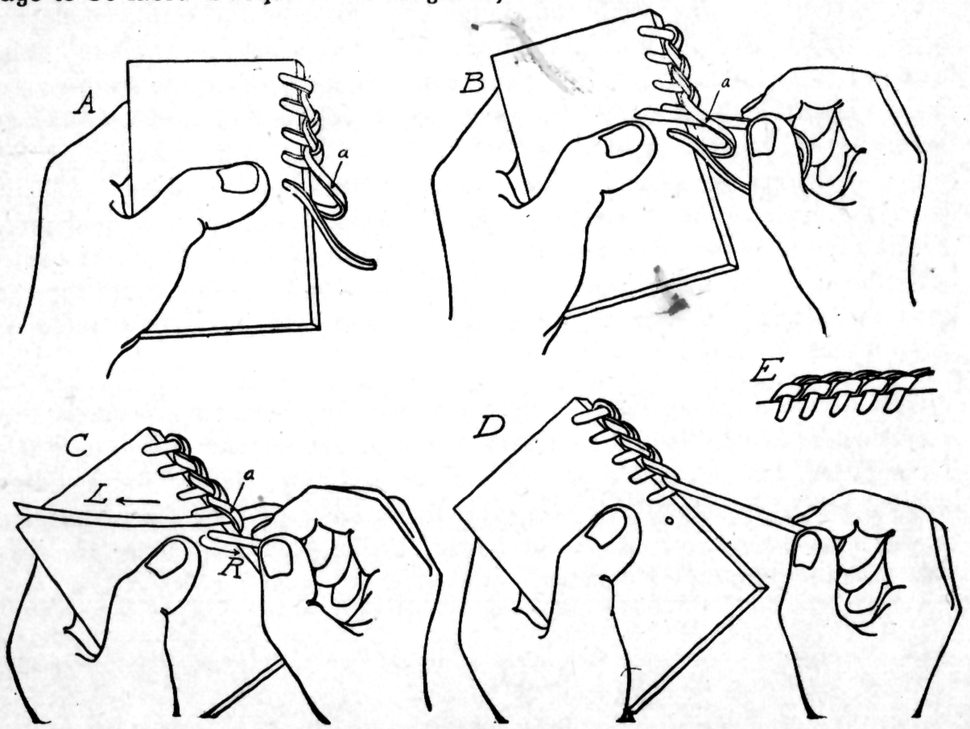


Fig. 5

Edge Lacing

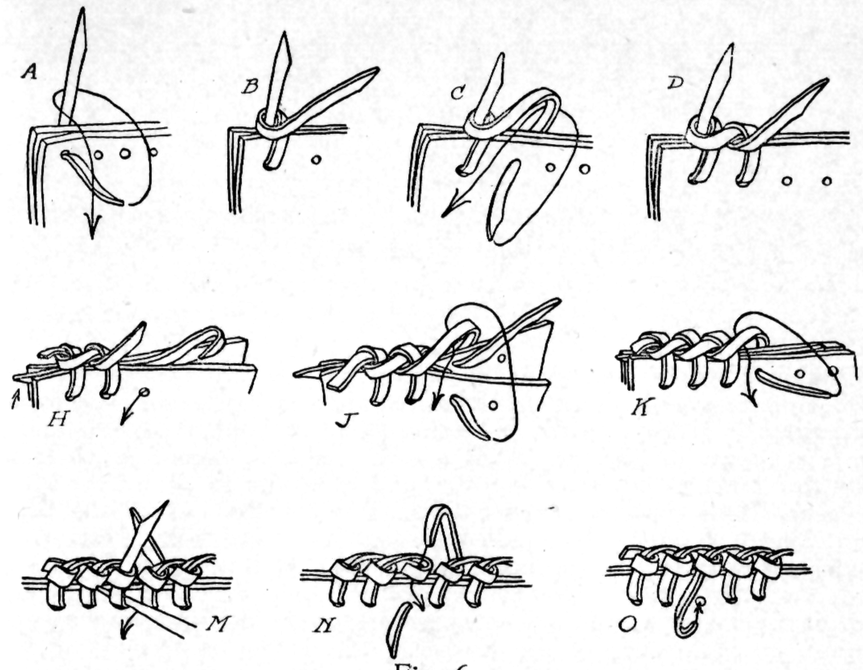


Fig. 6

Splice a Lacing Thong as shown in sketch, Fig. 6, Sketches H-J-K. Draw the new thong through the last two loops formed by the preceding thong and between the lining and the outside leather. Pass the new thong through the next hole indicated in Sketch H by the arrow. Pass the end of the preceding lacing thong through the corresponding hole in the lining as indicated by Sketch J. The end of this thong remains between the lining and outside leather. Form the next stitch with the new thong as indicated by the arrow, Sketch J. Pull the loop snugly down and press the lining and outer leather in place. Continue lacing with the new thong as indicated in Sketch K. The end of the preceding thong may be left free between the lining and outer leather or included within the next two stitches as preferred. In fact, both ends of the joined thongs may be left free between the leathers and make a satisfactory junction. It will require the use of a hook or pointed tool to loosen and remove the ends of the lacing. This method produces a less stiff and bulky edge than the one where the thongs are caught under the four loops of the edge lacing.

End the Lacing as shown in Fig. 6, Sketches M-N-O. This method is applicable to an article assembled with edge lacing which is joined at the starting point to make it continuous. Pull the thong end left standing as shown in Sketches A-B-C-D down through the loop as indicated in Sketch M. This step is shown completed in Sketch N, which also indicates by an arrow that the end of the other thong is to be passed down through the loop. Pull the end of the thong, see Sketch N, protruding through the leather, back between the lining and the outer leather. Insert the end of the other thong in the hole just vacated as indicated in Sketch O. Pull or fish the free ends of both thongs into the space between the lining and the outer leather. Adjust the tension of this loop with a marlin spike to give a uniform appearance to the junction.

Edge Lacing

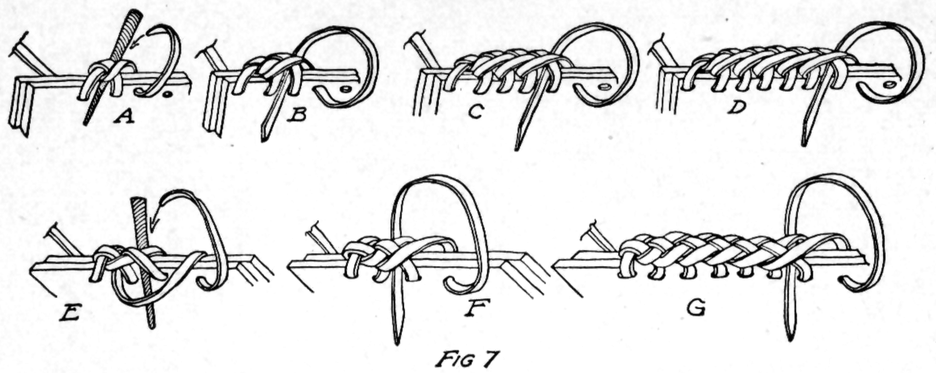


Fig 7

Double Layover Lacing as shown in the finished section, Sketch D, Fig. 7, differs from single only in the fact that as the lacing progresses the looped stitch is taken thru the preceding stitch as well as around and over itself. As shown in Sketches A, B and C, the first looped stitch is taken around the thong as in simple layover, and left loose to permit the insertion of a spike. This opens the space through which the end of the thong is passed, Sketch A, after it is pulled through the third hole. Note that the second loop is formed at the point where the first layover or looped stitch crosses back over itself. Sketches B and C show the next steps. As the double layover stitches are tightened progressively the appearance becomes the same on both sides of the leather, with the loops seeming to run in opposite directions. The vertical or right angle direction of the stitches, however, is on the outside as in single layover, with the slant coming on the inside.

To facilitate the lacing operation, the end of the thong should be cut to a tapered point, and it may be stiffened by the application of soap to the flesh side. Another device is to skive the end thin and glue smoothly around a small portion of a tooth pick. A lacing needle which tightly holds the thong end is shown in Fig. 6, page 52.

As compared with single layover lacing, the double style more nearly covers the edges of the two or more pieces of leather which are being assembled, and it is especially satisfactory in lacing bags or other articles, with gussets. The width of the finished lacing, as Sketch D, is approximately three times the width of the lacing thong and the appearance is that of a three plat braid or weave. A thong approximately six times the length of the edge to be laced is required for double layover lacing.

Triple Edge Lacing, as shown in the finished section, Sketch G, is detailed in Sketches E and F, Fig. 7. The difference between this style and the double layover described above is that each time a stitch is taken through

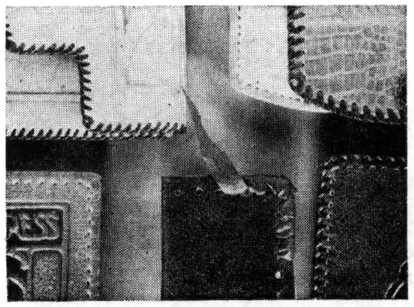
Triple Edge Lacing, as shown in the finished section, Sketch G, is detailed in Sketches E and F, Fig. 7. The difference between this style and the double layover described above is that each time a stitch is taken through the leather, the thong is carried back under the last and the two preceding loops at the point of crossing shown where the spike is inserted, Sketch E, to permit the thong to be pulled through as indicated by the arrows. Triple lacing has a top or edge appearance of an under one-over one four plat flat braid, and is approximately four times the width of the single thong. The amount of thong required for triple layover lacing is approximately seven times the length of the edge to be laced, and it will completely cover several thicknesses of leather.

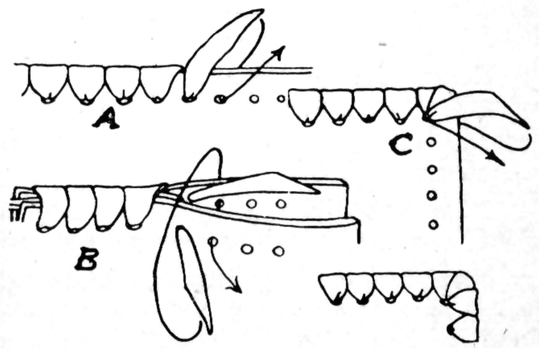
Edge Lacing

With any of the foregoing types of edge lacing the following principles must be observed to insure neat appearing work. Keep the margin between holes and edge exact by following carefully the creased line as shown on page 52, as a guide in punching. Do not permit the thong to get twisted. This may be prevented by running the thumb and forefinger back from the edge of the leather to the point of the thong end before inserting it for the next stitch. Do not try to work with too long a thong. A two yard length is as long as may be easily handled, and if care is taken in splicing as described, the ends will not be noticeable. More important is the caution against pulling the lacing too tight.

The finished lacing should lie along the edge and not be pulled to either side, or pucker the edges of the leather. In finishing the lacing the end may be concealed by trimming to a narrow long point and then running it back under the lacing several stitches. This will be easily done if the last three or four stitches are left loose and then tightened by pulling up carefully the separate loops, after the end has been run back. The final step in the process is to flatten the lacing by pounding with a smooth wooden mallet.

Wide Lacing of the Florentine Type is effective and most suitable for flat cases, note books and larger articles where a smooth, flat edge finish is desired. It is especially suitable for articles made of steerhide, as matching or contrast thongs of the same leather can be obtained or made by hand by the method which will be described later. The sketches and illustration, below, show the method and appearance of wide whipped edge lacing. In lined articles, short lengths of thong can be used as the method of splicing is simple, the thong ends being concealed as shown in Sketch B. The holes should be spaced so that the thongs touch and conceal the edges of the leather, and it is usually necessary to go through the corner holes two or three times to cover the corner edges as shown in Sketch C. For holes $\frac{1}{8}''$ from the edge and spaced $\frac{1}{4}''$ apart, a thong or thongs approximately $2\frac{1}{2}$ times the edge to be laced will be sufficient.





Edge Lacing

Four Plait Round Edge Lacing

This type of edge lacing which resembles a strand of four plait round is made with a single thong. The procedure is as follows:

1. Pass the thong through the first hole in the leather from back to front. See Sketch A.

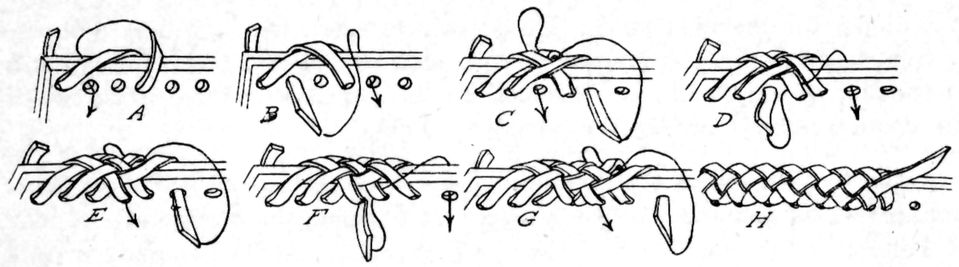


Fig. 8

2. Carry the thong over the edge and pass it through the fourth hole from back to front. See Sketch A.

3. Carry the thong over the edge and pass it through the second hole from back to front as indicated by the arrow in Sketch A. Sketch B also shows the thong through hole No. 2.

4. Carry the thong over the edge and pass it through hole No. 5 as indicated by the arrow in Sketch B. Sketch C shows the thong protruding from hole No. 5.

5. Carry the thong back to hole No. 3, passing it over the thong (extending from holes No. 2 to 5) and under the thong (extending from holes 1 to 4). See Sketch C. The thong is shown protruding from hole No. 3 in Sketch D.

6. Carry the thong under the thong (extending from holes 4 to 2) over the thong (extending from holes 5 to 3) over the edge and through hole No. 6 as indicated in Sketch D. The thong is shown protruding from hole No. 6 in Sketch E.

7. Again carry the thong over and under a thong as before. See Step 5 above and pass it through hole No. 4. This step is indicated by the arrow in Sketch E. The thong is shown protruding from hole No. 4 in Sketch F. The arrow in Sketch F indicates that the thong is to pass under and over a thong, over the edge and through hole No. 7. In Sketch G the thong is shown protruding from hole No. 7.

Repeat the process described in step No. 5, carrying the thong over one and under one and back through hole No. 5.

The appearance of a section of edge laced as described in Steps 1 to 7 is shown in Sketch H.

This method of edge lacing is sometimes used to attach the fleece lining to the skirting in the fancy silverplated saddles made in old Mexico.

Numerous other applications suggest themselves. Allow ample time to do this kind of lacing and use a thin edged thong for best results.

Hand Methods of Making Lacing

Hand Methods of Making Lacing may readily be learned and are useful when it is not possible to obtain the commercial products. Wide lacing is made from strips of leather, preferably steerhide, which are cut the length of the skin, or "side" (half-skin), as it is termed. This must be taken from the back or firmer portion of the leather. A hand gauge method of cutting wide thongs from a straight strip is sketched, Fig. 8, and the operation of thinning or skiving is also indicated. A shallow groove, the width of the thong and sloped from the surface toward the edge, is cut or filed in a piece of hardwood which is clamped or screwed firmly to a support. The thong is held in the left hand with grain or smooth surface down in the groove, with the loose end hanging over the edge. It is slowly pulled in the groove from right to left, against the knife blade placed across the groove with the edge at the angle indicated, so that a thin shaving is cut from the upper flesh side of the thong. Success in skiving a wide thong requires a steady hand, a sharp thin-bladed knife and a correctly sloped, perfectly level groove. Skill in holding the knife and in pulling the thong steadily are easily acquired with practice.

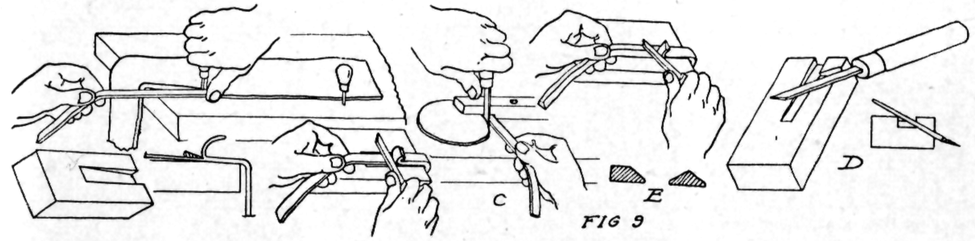


FIG 9

Narrow lacing is usually cut from a circular piece or disc of firm leather, calf or goat skin, and a hand method is shown in Sketch C. In skiving a narrow thong a groove is necessary as above described for wide lacing, and the thong is placed and pulled as before. The knife, however, is held at an angle which cuts a triangular shaving from one side, leaving it beveled toward the edge, Sketch D. The thong ends are then reversed and it is again skived in the same way to produce a bevel on the other side. An enlarged cross section, Sketch E, shows the comparative thickness of the center and edges of a bevel skived thong. See thong cutter method page 104.

The under and lighter side of a skived thong, either wide or narrow, may be dyed with a leather dye or stain, which is applied with a swab as the thong is held taut with one end thumb tacked to a support. The rough surface may then be smoothed by rubbing with a slightly waxed cloth.

Tooling Steer and Calfskin

1. The group of **Coin Purses** shown in the illustration may be made of either Steer or Calfskin. Both may be used unlined but the inside finish of the Steer is neater if lined. A simple single coin purse as No. 1 involves less assembly detail than other purse projects and is desirable as a first attempt for beginners.

a. **Single Coin Purse.** (Calfskin.) Dampen, crease edges and transfer design as detailed on page 33.

b. Apply tooled decoration and permit the leather to dry.

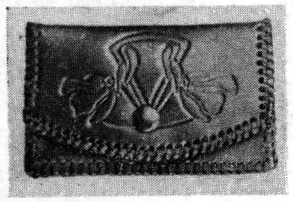
c. Skive the edges which are to be united.

d. Cement the front and back together along the edges only and deepen the edge crease.

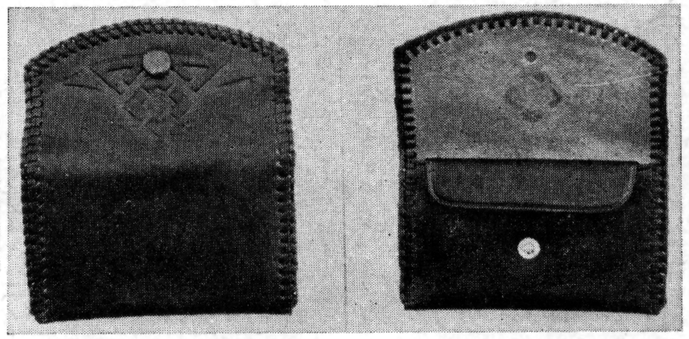
e. Start at one corner and punch the holes, using the gauge punch. Adjust spacing if necessary to bring the holes in the corners. The method is shown in A and B, page 58.

f. Lace, starting about three holes below one top edge of the front.

The same procedure is followed when steer hide is used except that the front edge is turned under at the top, see page 37. If a lining is used see cementing of linings and method of holding to avoid folds in the lining, page 37.



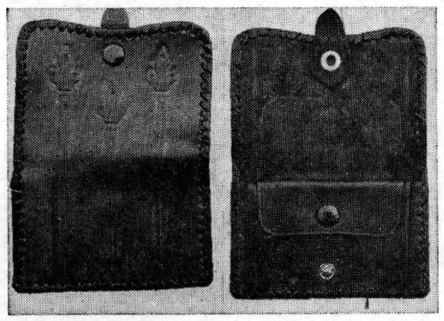
1



2

2

2. **Double Coin Purses** and **Card Case Coin Purses** are constructed in about the same way except for the insertion of the additional pocket or purse flap. These must be skived thin at the edges so that the combined thickness will not be out of proportion with the single flap. Cement carefully in position before punching, and trim if necessary to make all margins straight. Nos. 2 and 3, double coin purse and card case coin purse are made of Steer hide and the edges of fronts and pockets are turned under as shown. No. 4 is gusset type double coin purse with a folded pocket of the bellows type.



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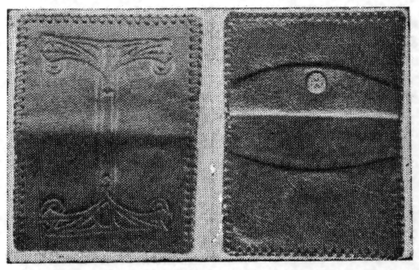
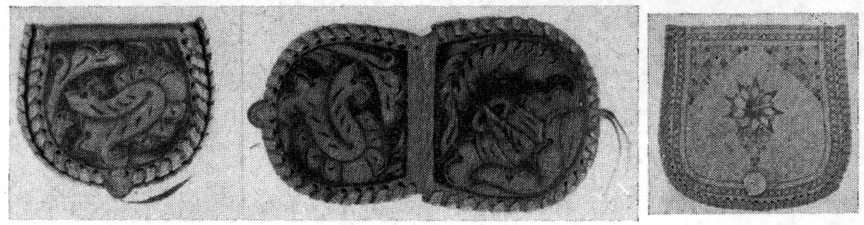


3

Tooling Steer and Calfskin

3. **Folding Coin Purse.** (Tooling Vealskin or heavy Calfskin, Goat.)



Firm leather is required. The illustration shows vealskin carved, and goatskin stamper. Method of tracing design and carving is detailed on pages 41 and 42. Stamping is shown on page 45, also under Morocco Stamping, page 47.

Assembly detail is shown in the sketches, page 88.

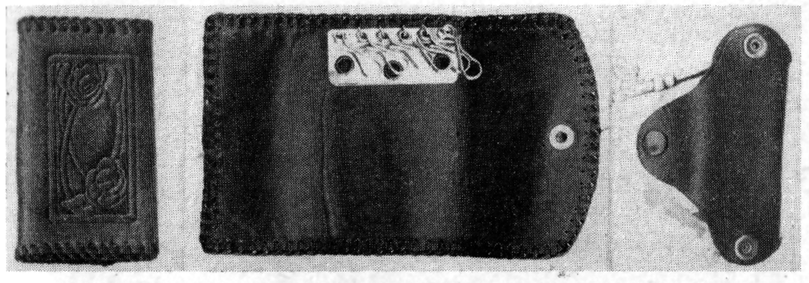
4. **Keytainers.**

Unlined Keytainers may be made of heavy Calfskin or Steer and these are not necessarily laced. The key plate is attached directly to the outside piece.

a. Dampen, crease and apply design. A panel, either a monogram or conventional design is usually applied to the center as illustrated, though a small design may be tooled on the flap if desired. If the purse is not to be laced edge creasing and staining (if the leather is dark) will complete the project. The key plate and snap fastener may be attached either before or after the design is tooled. It should be done last if it interferes with the design.

b. The keytainer of the swivel plate type of steer, illustrations A and B, should be lined with matching goatskin. The key plate is attached to the lining and this cemented and laced to the outside piece which has been tooled. See tooling, cementing and lacing procedure, pages 33 and 34 and pages 50 to 58.

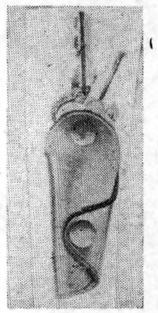
C and D shows a post type keytainer. Post attachments shown on page 54.



A

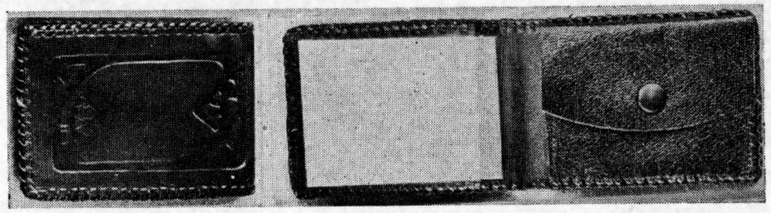
B

C



D

Tooling Steer and Calfskin Projects



5. **Memo Pad Purse and Bill Fold** with coin pocket. (Steer or Calfskin.)

a. Dampen and apply panel decoration, as illustrated, monogram or emblem to the ends, fold in position and dry.

b. Skive edges and stitch the coin purse section to the lining.

c. Cement the pocket, which has been creased or turned down at the top, to the lining and then the lining to the outside, smoothing from the center fold to the ends to prevent buckling. Trim uneven margins.

d. Punch and lace, starting near the upper edge of the pocket.

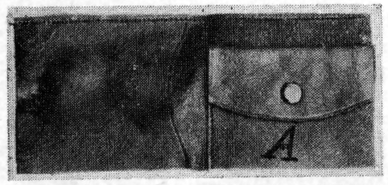
5A. **The Coin Pocket Bill Fold** is assembled in the same way except that the Bill Fold has an additional bill pocket which must be stitched along the upper edge after pockets are in place. If cut of dyed leather the unlaced edge should be stained. Steerhide is especially satisfactory for this project as thinner sections may be used for the lining and pockets. A neat finish for the top of the pocket is obtained by cutting the lining sufficiently wide to permit the unlaced edge to be skived and turned down before stitching.

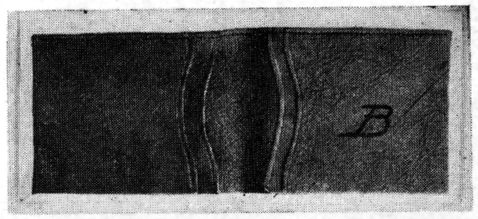
e. Punch upper outside edge and lace first, cement lining in position with outside folded, and lace together around remaining three sides. Cut A shows lining.

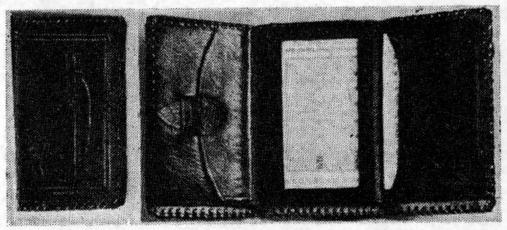
6. **Bill Fold for Small Bills, Double Pockets.** (Steer, Calfskin.)

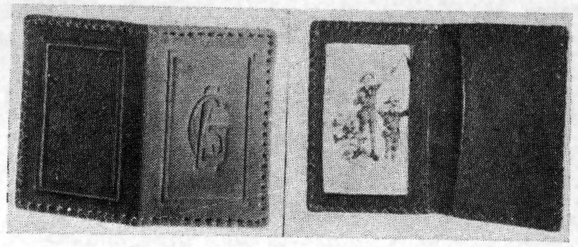
a. Cut B shows the appearance of the lining section with the double pockets in place and stitched along one edge.

b. Assembly follows that detailed for No. 5A.









7. **Photo Holder and Identification Card Case.**

a. The parts consist of an outside piece, window for photo or card, celluloid, lining and in the Identification Case an additional card pocket.

b. Tool the outside front and back panels as previously directed, permit to dry folded in position.

c. Stitch the celluloid (along the inside edge only) to the window section, which has been creased.

d. Cement the lining, window and pocket in position and crease guide line for punching.

e. Punch and lace using wide or narrow lacing. The lacing should start at a point that will permit the ends of the thongs to be concealed under an inside edge.

8. **Photo Frame, Easel Type.** (Steer or Calfskin.)

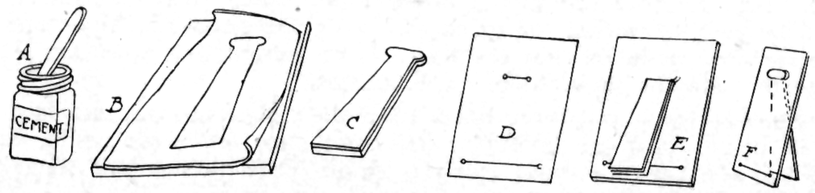
a. The decoration is applied to the frame opening which is suitable for many forms of border and corner designs.

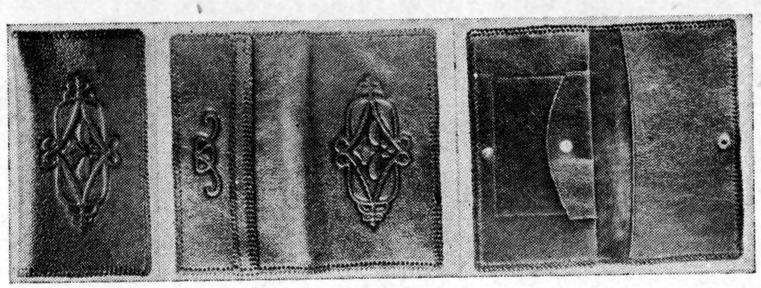
b. A metal easel may be attached or a leather easel constructed as indicated in the sketch which also shows method of attachment to the back, and slit for inserting photo. Soft leather is stiffened by cementing to strap leather, Sketch B.

c. Decorate frame and permit it to dry.

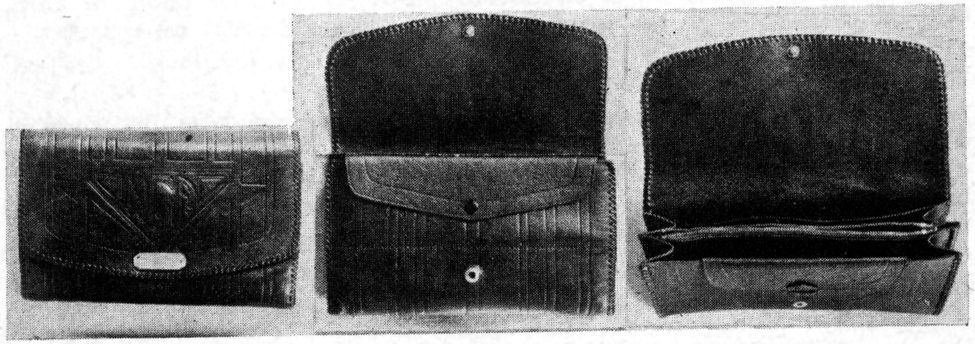
d. Cement together at the edges, the frame, celluloid the same size, and the back to which the easel has been attached.

e. Crease, punch and lace, using wide or narrow lacings.





No. 1



No. 2

9. **Envelope Bags.**

Three styles of envelope purses are illustrated. No. 1 is without gusset, and has two straight pockets and a stitched coin pocket. This is constructed the same as the flat square cornered coin purse except that the pocket must be stitched in place before the parts are cemented for assembly. Concealed snap fasteners are attached to the pockets as shown in the illustration. The use of the handle is optional. Lining required.

No. 2—Envelope Bags are constructed as follows:

a. Dampen and decorate the flap of the outside piece, also back panel if desired, and permit to dry in a folded position with tissue paper inserted to preserve the shape.

b. Construct pocket and gussets as directed under assembly procedure, pages 51 and 67.

c. Skive and turn inside edge of purse section over lining.

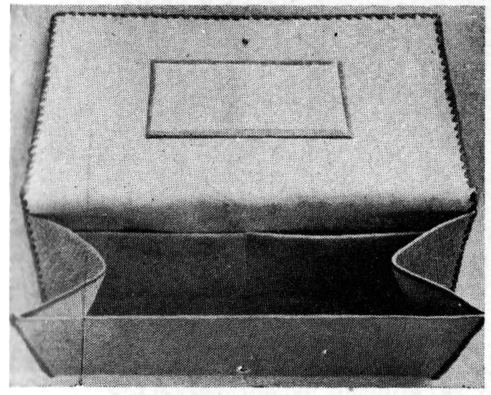
Cement the lining to the outside, smoothing from the folds outward as directed on page 50. If pockets are desired these should be stitched in place with the upper edge skived and turned under (cemented down). These should not extend to the edge of the lining unless skived very thin.

d. Insert the gussets and cement lightly along the edges as directed.

e. Punch the holes, using spacing gauge. Start about 1/8" from the top of one gusset and punch around the gusset, flap and second gusset. Care must be taken to hold the punch horizontally when punching the bottom curve of the gussets so that the holes will not slope outward. Also be sure to estimate distance of holes near the tops of the gussets and space so that no hole cuts through the top fold of either gusset.

f. Start lacing about three holes from the top of gussets and lace both gussets in place. End the lacing at the front edge as shown under lacing, page 57. Lace the flap last, using a single long thong (six times edge length). Splice into gusset lacing as directed on page 57.

Under Arm Bags Slide Fastener Assembly



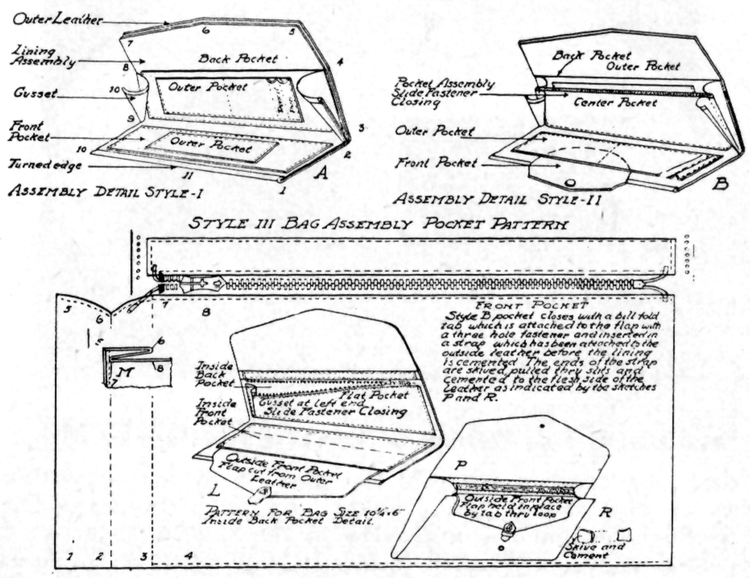
A

B

Two styles of Under Arm Bags are illustrated in Cuts A and B. Style A is a single compartment bag with front and back pockets stitched to the lining. See gusset detail assembly, page 51.

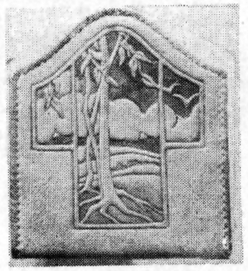
Three pocket patterns are detailed in the assemblies for Styles I, II and III, shown below.

Style B Bag is a "flapless" type. A slide fastener attached to a gusset similar to the Brief Case is used. See detail of the slide fastener gusset assembly, pages 72-73.



Book Ends. (Steerhide as illustrated or Calfskin.)

The outside pieces are cut ⅜" larger all around with additional length at the curve of ½" to allow for the bending of the metals. The inside lining is cut larger on all edges except at the bottom where it may be about ⅜" shorter. Sheet wadding is required for padding the outside.

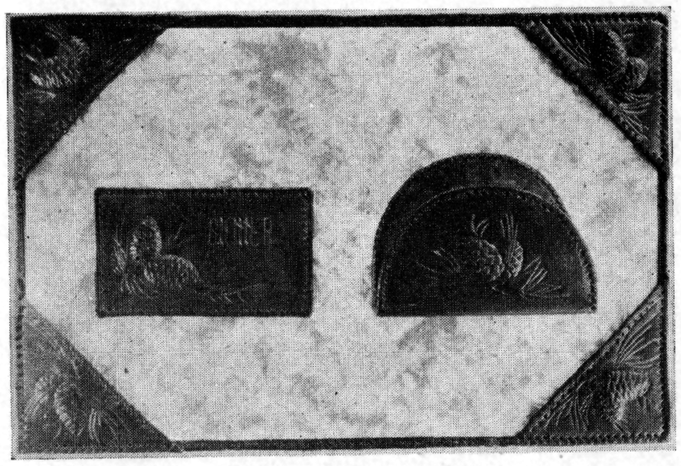


a. Apply decoration to the design area of the front section. A creased line is shown which gives a border effect, but this is not necessary. Relief tooling is attractive and very suitable for book ends since the metal forms prevent any flattening of the design. Slightly pad with sheet cotton wadding to fill out the raised design.

b. Cement the lining to the bent metal form, smoothing out all wrinkles. A thin piece of the steer is satisfactory for this purpose. Stretch the sheet wadding over the outside and cement along the edges and at the fold. Carefully place the outside in position and cement to the wadding and to the edges of the inside lining which extends beyond the metal edge.

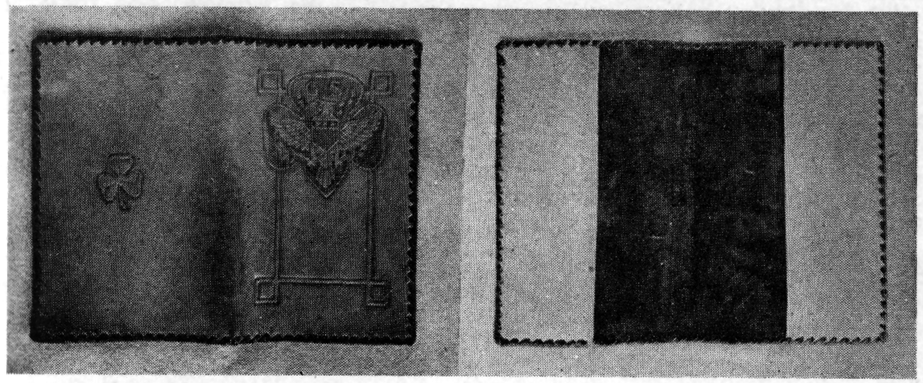
c. Punch carefully, avoiding contact with the edge of the metal. A margin of ⅛" should be creased and followed as a guide in punching.

d. Lace, using wide whip lacing.



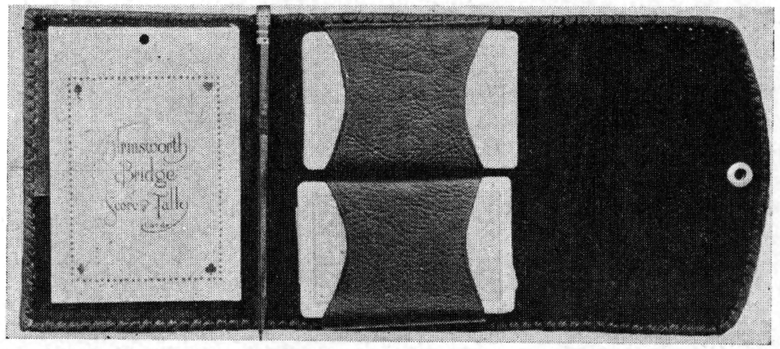
Desk Sets, Blotter Pad Corners. (Steerhide, Calfskin or Morocco.)

This desk set consists of a blotter pad to which are attached the four corners or end strips, small blotter and letter holder. The holder requires a metal form and is constructed in the same manner as the book end previously descibed. The small blotter is edge laced to the lining and a piece of blotting paper attached with a metal clip or with thongs. The corners are assembled as described on page 71.



Note Books.

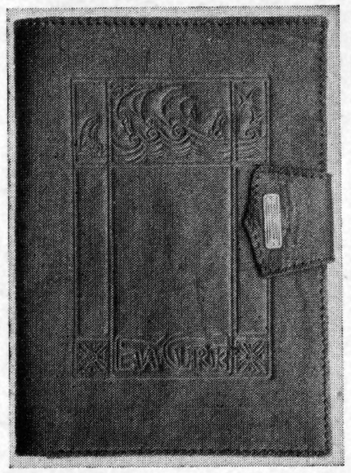
A slip over style note book cover is illustrated here. Pockets are laced to the cover which is slipped over the original note book cover to which the clips are attached. It must be cut ⅜" larger than the cover which is to be inserted, with an additional width of 1 inch for the fold. This cover is suitable for a regulation book cover as well.

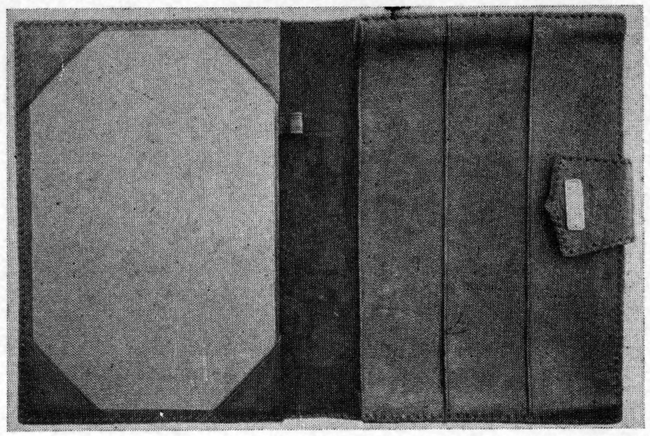


Bridge Set.

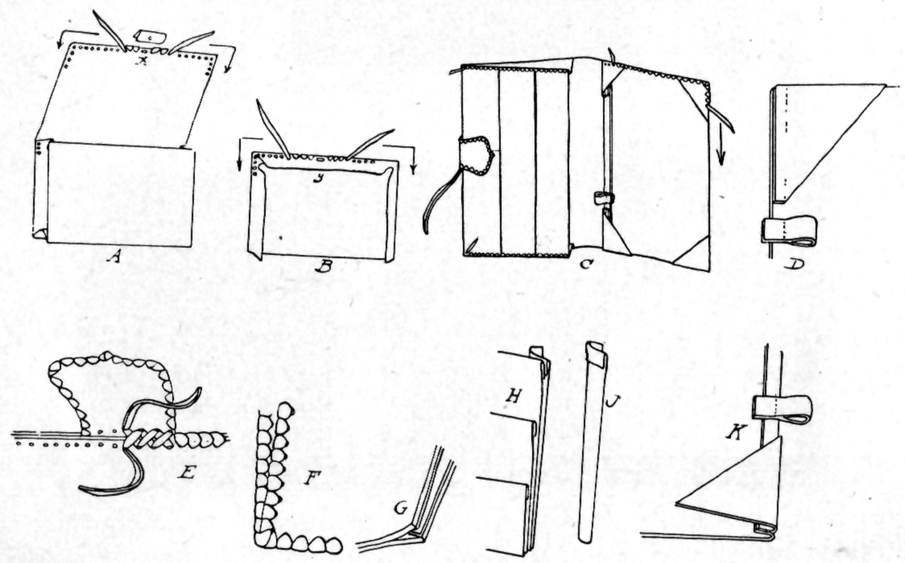
A Bridge Set and a Playing Card Case are shown in the illustration, which also shows the inside of the bridge set with the cards and score pad in place. The set is made of Steerhide and the single case of Calfskin.

In the Bridge Set an outside piece, suede lining, pocket piece for cards and for base of pad are required. The piece for the card pockets is shaped as illustrated and sufficient width is allowed to permit the insertion of the cards. This piece is edge creased, skived on the ends and stitched in place exactly in the center. The ends are cemented to the lining and then laced in with the outside. The score pad pocket is cut slightly longer than half the shaped card pocket piece. This is stitched on the inside edge to which is attached a loop for the pencil. Wide or narrow lacing may be used.





The Writing Portfolio illustrated is made of tooling steer in a two-tone mottled brown and laced with wide matching brown thongs. It is an advanced project requiring considerable skill but may be constructed without difficulty if the directions are followed exactly.



a. Apply a tooled decoration to the outside piece. A panel design which may be simplified and used for the back as well is effective. A name or monogram may be worked into the bottom panel as illustrated. Crease

Portfolio Assembly

the edge for the punching guide and allow to dry in the folded position. Attach the base of a Portfolio Lock, see page 86, or Bag Plate post and cage in position, see page 55.

b. Overlapping pockets, two or three as shown, are cut long enough to turn under for the finish at the top edges. These are skived very thin along all edges and cemented to the gussets which are prepared as in sketch H. If any small pockets are desired sections of the outside pocket may be stitched.

c. Punch and lace the over lapping pockets to the gusset and end the thongs by inserting the last inch back through three loops of lacing.

d. The base for the blotter pad, also the two inner corners are cut 3/8" longer on the upper edge to permit stitching in place as indicated in Sketch D. All edges of the corners are skived thin and the diagonal is turned under and creased. Stitch the inner edge of the pockets and the pencil loop as shown in Sketch D, turn them back, Sketch K, and cement the other edge to the lining. Cement the seam to the lining and cover the surface with a thin piece of skiver. Turn under, cement and crease the outer corners along the diagonal and then cement them to the lining edge.

e. Insert a piece of buckram between the suede lining of the portfolio and the outside, cement the blotter pad section to the suede along the edges, and then cement the whole suede lining smoothly to the outside, folding at the center as in sketch. C.

f. Punch and lace the blotter pad section to the outside, then cement the gussets to the lining and the outside. Punch around the remaining edge and lace along the gusset edges then across the bottom as far as the center where the fastener strap is to be inserted. This is cut double of thin sections, cemented and laced around the sides and end. The Bag Plate is attached and the strap inserted between the outside and lining. There should be about one inch open space between the covers when the snap is fastened. Position the strap exactly and mark the two rows of holes as indicated in Sketch E. Remove the strap and punch the holes as marked. Replace the strap in position and cement the edges together, making sure that the holes coincide. Continue lacing, using the ends of the strap and edge thong to form a double cross lacing. Insert the ends between the lining and the inner pocket, pull through smoothly and cement to the back of the pocket. Insert blotter, or a smooth writing surface of celluloid or press board may be substituted if desired.

This portfolio may also be constructed with a straight gusset as shown in brief case, page 86.

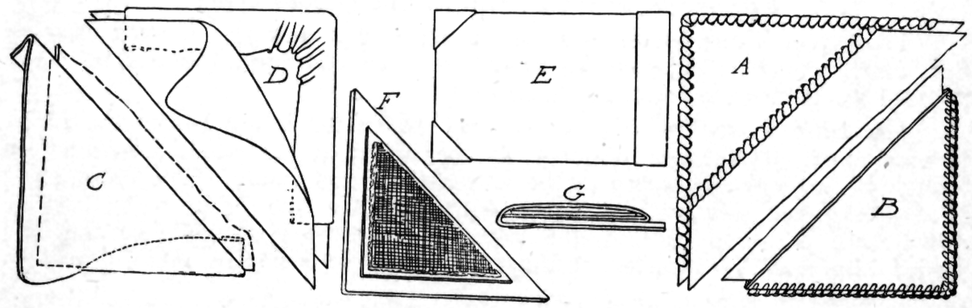
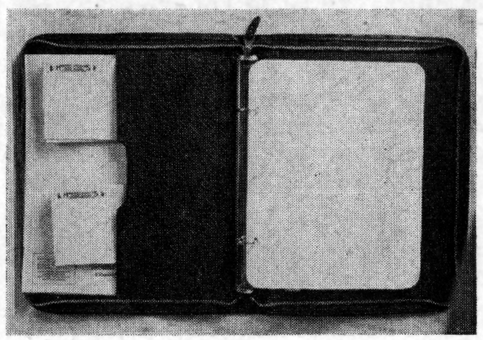


Fig. 7

Brief Case—Slide Fastener Assembly



Suitable Leather

Boarded Cowhide, 3 to 5 oz.

Tooling Steerhide, 2½ to 3 oz. Lining Skiver or goatskin may be stiffened with buckram.

Strap leather, 4 to 6 oz. for stamped decoration. With any of these leathers use goatskin or steerhide for gussets.

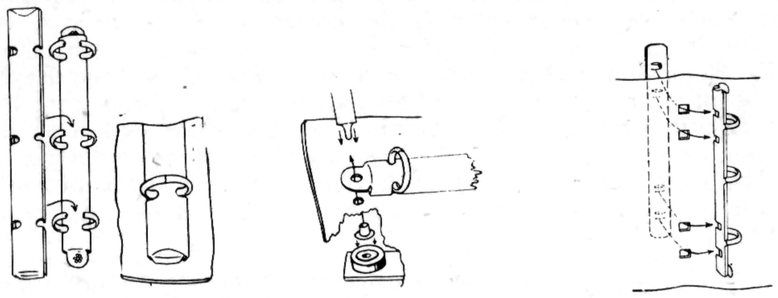
Assembly Procedure

1. **Cut One Piece of Outer Leather** the size and shape of pattern. One half of pattern is shown. The pattern may be drawn to actual size. One inch squares are indicated. Cut the lining to pattern.

Cut leather for pocket assemblies according to detail indicated, Sketches A1 and B1. Cut two strips of leather for gussets 1″x38″ and one cover piece 2½″x13″, also two cover pieces 2″x3″ from gusset leather.

2. **Make the Gusset Assembly** as indicated in Sketches C-G-H-J-L. The end of the slide fastener tape is concealed by cover piece, 1-2-a-b, Sketch H, and stitch to the lining along dotted lines indicated in Sketch H. Similarly the other end of gusset is attached at point 3 and 4 as indicated by Sketch J.

3. **Make the Lining Assemblies** as indicated in Sketch K. Attach a ring note book metal to lining if desired. Cement the lining assembly to the outer leather. Cement leather cover strip on edge of slide fastener tape to the outer leather. Punch for lacing as indicated in Sketch M.

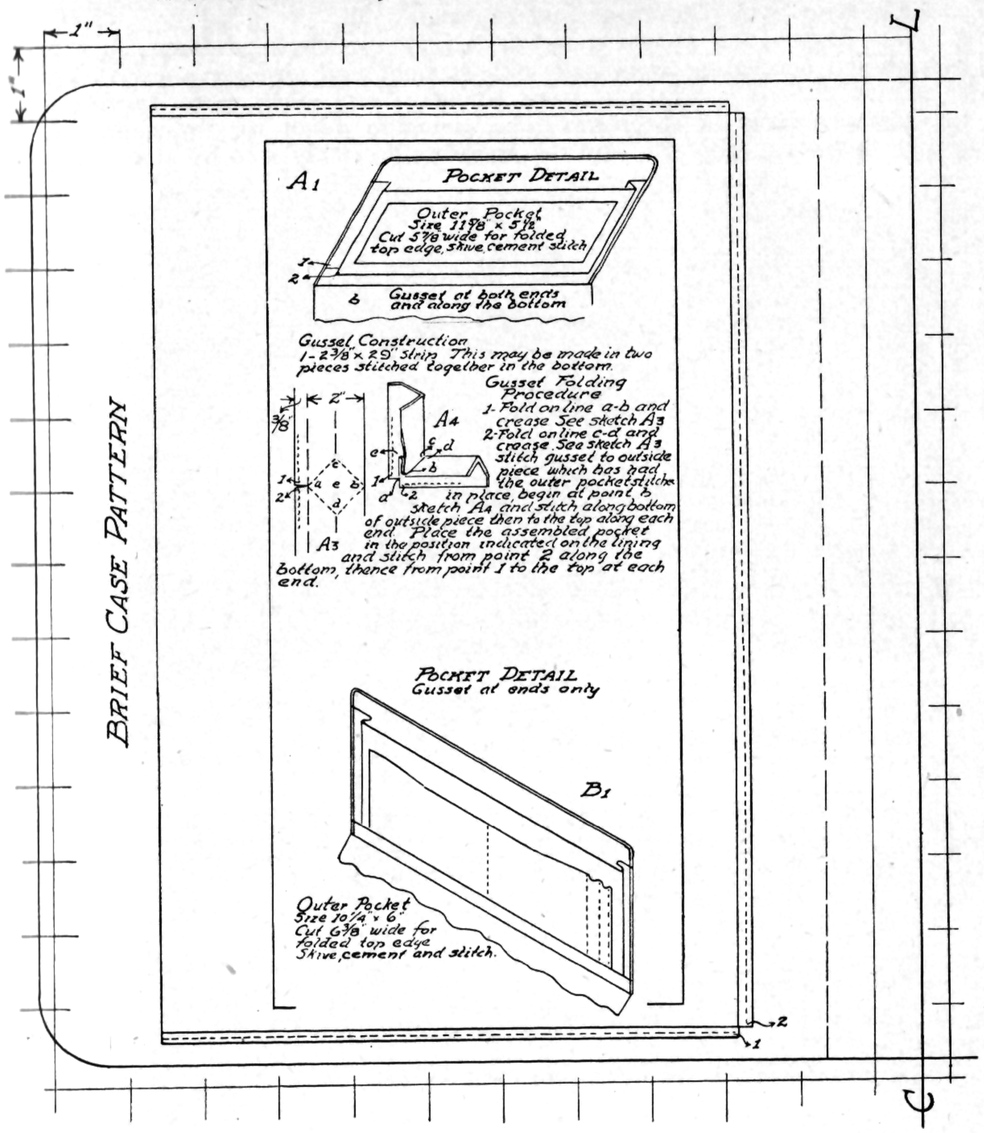


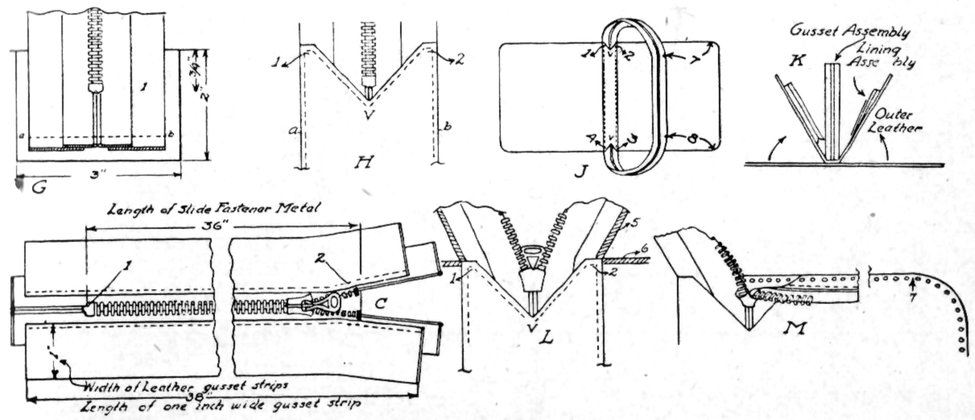
Attachment of Note Book Metals (Loose Leaf)

The Rivet Type Metal may be attached to a lining or riveted through the outside cover as indicated in Sketch A. An additional metal shield may be used to conceal the rivets as illustrated.

The Base Plate Type Metal is attached to the lining before the cover is assembled. Holes are punched in the lining at the points indicated in Sketch B, and corresponding to the loops in the base plate. The lining must be skived if not sufficiently thin to permit the inner ring plate to be pressed down until the loops are in line with those in the base plate so that the wedge clip may be inserted through both sets to hold the metal firmly in place, as shown at C.

Parts of Rivet and Base Plate Note Book Metals are shown in the illustration.



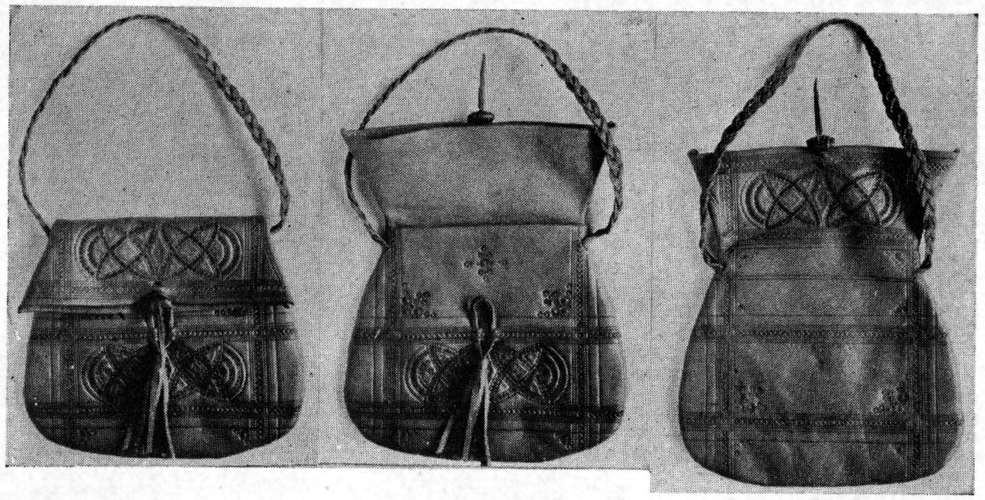


Gusset Detail

LEATHER PROJECTS—TOOLING STEER

Morocco Style Handbags and Purses.

The illustration shows a morocco style pouch hand bag. This type of stamped decoration combined with straight and circular lines is applied to natural Steerhide which is very attractive and much more durable than the morocco bags of sheepskin. The stamping detail for the hand bag is shown in the cut, page 71, and the complete assembly step by step in Fig. 1.



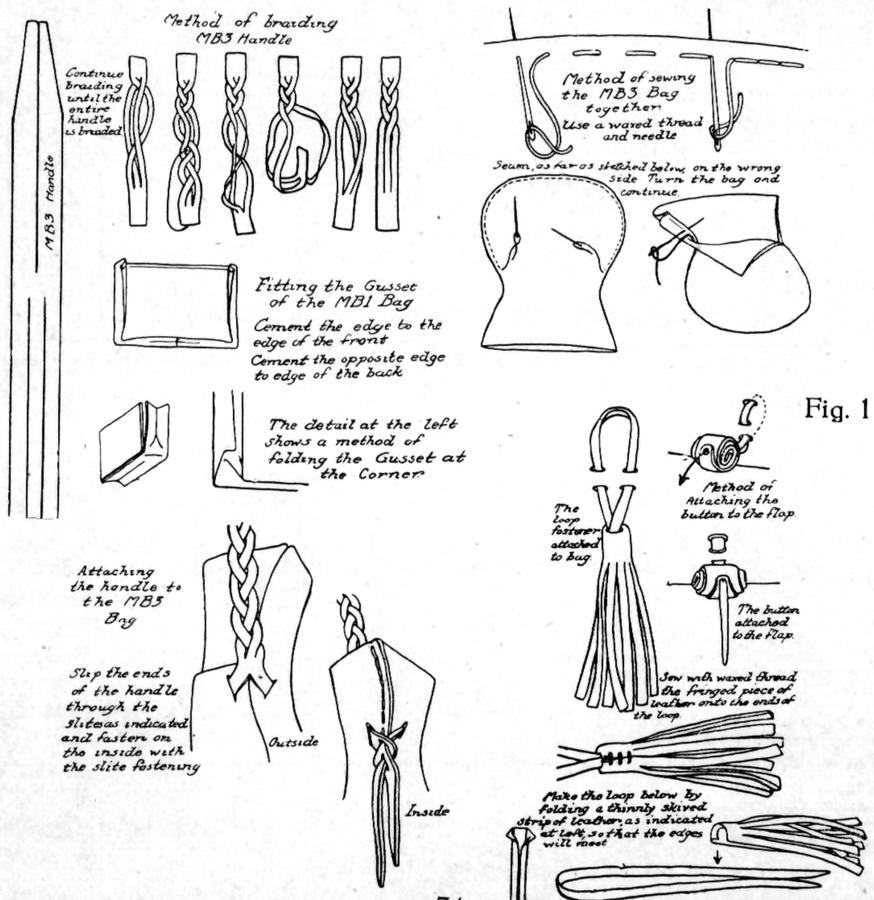
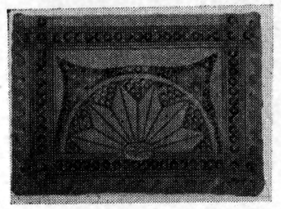
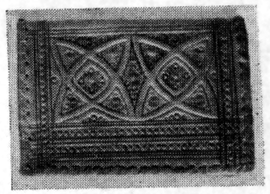


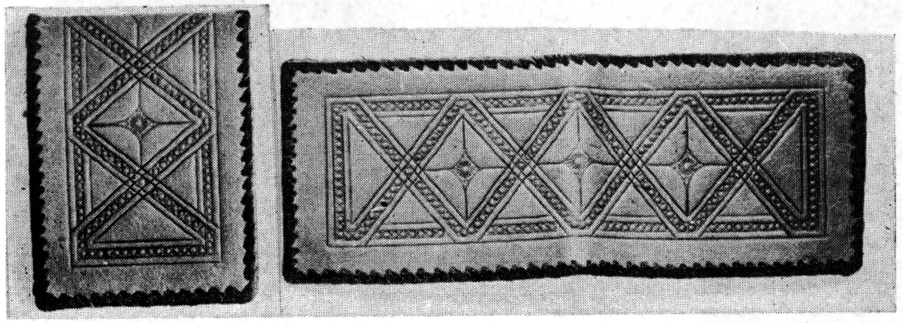
Fig. 1

LEATHER PROJECTS—STEERHIDE

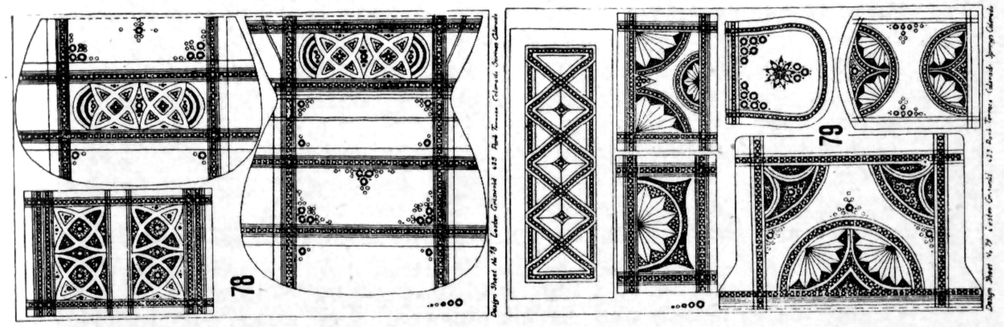
The **Coin Purse, Card Cases, Envelope Bag** and **Bill Fold,** illustrated are assembled with wide edge lacing following the procedure described on page 62. A fascinating variety of designs may be secured by using the few simple stamped motifs in combination and repetition.







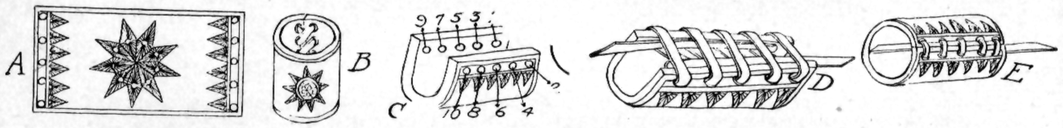
The border and design lines shown in Cuts 78 and 79, below, are creased first. The stamped background is then applied. Stamping procedure is described and page 46.



Strap Leather Project

1. **Neckerchief Slide—Tube Type.** The slide shown in Sketch B is made from a piece of strap leather with stamped decoration applied as indicated. The procedure in laying out two kinds of rosettes with the pine tree stamping tool is shown on page 46. The method of punching and lacing is sketched below. The jeweled ornament may be applied as described on page 47. Other decorations may be painted or tooled, using Camp Emblems, Totems, or Indian designs. The steps in making the neckerchief slide follow.

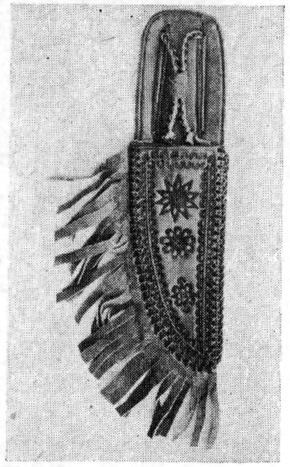
a. Bevel the edges, dampen and crease.
b. Stamp or tool, apply metal ornament.
c. Lace.

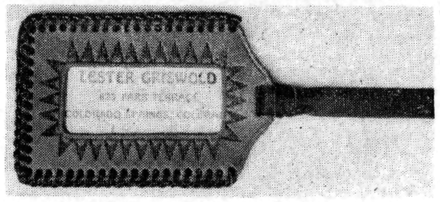


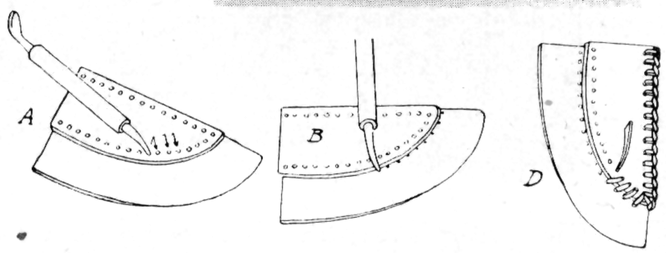
1 2

2. **Bag Tag.** The Bag Tag illustrated may be made from 4 oz. cowhide or tooling veal. It shows a stamped border decoration around the card opening. A stamped motif or a tooled design may be applied to the back. The card and a piece of celluloid is inserted before the strap is attached. See page 82 for strap attachment.

a. Bevel the edges, dampen and crease. (Omit beveling on vealskin.)
b. Stamp or tool.
c. Lace the edges and attach the strap as shown on page 82.







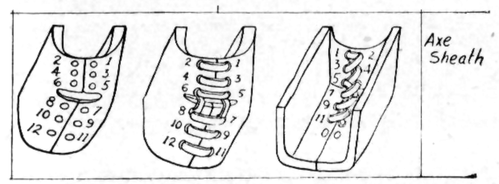
3. **Knife Sheath.** (Cowhide.) Plaiting, stamping and edge lacing are combined in this project which offers excellent opportunity for practice in these forms of leather craft, before more difficult projects are attempted.

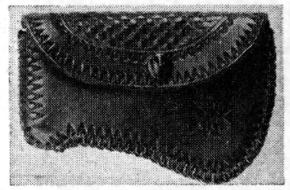
a. Bevel, dampen and crease outer edges and belt slits.
b. Punch top and bottom holes in front and back and tie together.
c. Punch the two thicknesses from left to right, starting from the upper corner hole.
d. Untie and lay the front over the fringe as in Sketch A. Mark one row of holes through those already punched and another row on the fringe at the edge of the front and opposite the first row of holes.
e. Punch the fringe holes as marked and tie the three parts together at the corners. Lace the straight edge first, using lay over stitch to the tip. Continue lacing through front, fringe, and back, using whip stitch.
f. Plait keeper thong and tie sliding knot. See pages 106 to 111 for plaiting instruction.

Strap Leather Projects

Axe Sheath. (Cowhide). This project is similar to the knife sheath, but the fringe is not included in the illustration. It may be inserted if desired and laced as indicated for knife sheath.

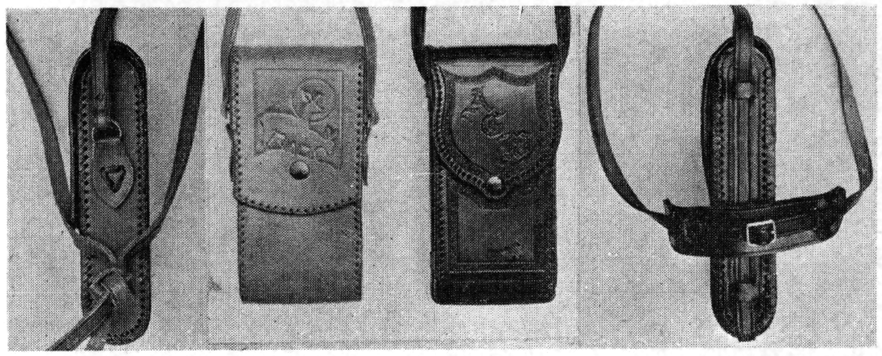
a. Bevel the edges. dampen and crease.
b. Stamp the flap and corner of the front.
c. Punch and lace the back edges as shown on page 54.





d. Lay front and back in position and punch end holes. Tie these together and punch remaining holes.

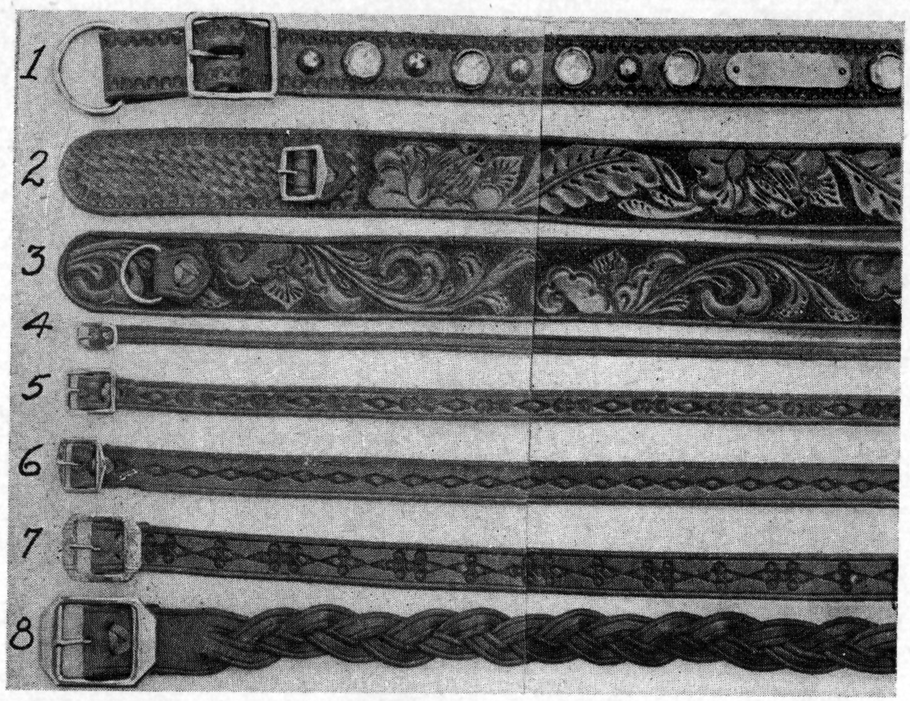
e. Lace, using whip or lay over stitch.



Camera Case. (Cowhide, 4 or 6 oz.) Since this project involves the setting in of gussets it is more advanced than the preceding four strap leather projects. However it is readily done if the procedure in lacing is carefully followed. The illustration shows two styles of flaps, also buckle attachment with shoulder strap and two strand Turkshead fastening.

a. Bevel the edges, dampen and crease.
b. Tool, carve or stamp the flap decoration.
c. Follow punching and lacing procedure detailed on page 53.
d. Attach dee loops and straps. Fasten strap ends with knot or buckle as illustrated. See attachments, page 81.

First Aid Kits and other cases having square corners are assembled in the order detailed for the Camera Case except that the stitch is doubled or tripled as necessary for the corners.



A Stamped or Carved Belt of natural cowhide or vealskin (vegetable tanned, unglazed) is readily made after the detail of stamping and carving has been mastered as described on pages 41 to 47.

a. Carefully bevel the edges, dampen and crease as in previous strap leather projects. **Omit the beveling for vealskin.**

b. Plan a suitable stamped or carved motif for the section which will be the center of the back. A group of belt panels is illustrated above. A carved design requires a tracing which is transferred to the dampened surface of the leather as described on page 42. Stamped designs should be planned on paper so that the space will not be crowded, and the designs balanced for arrangement.

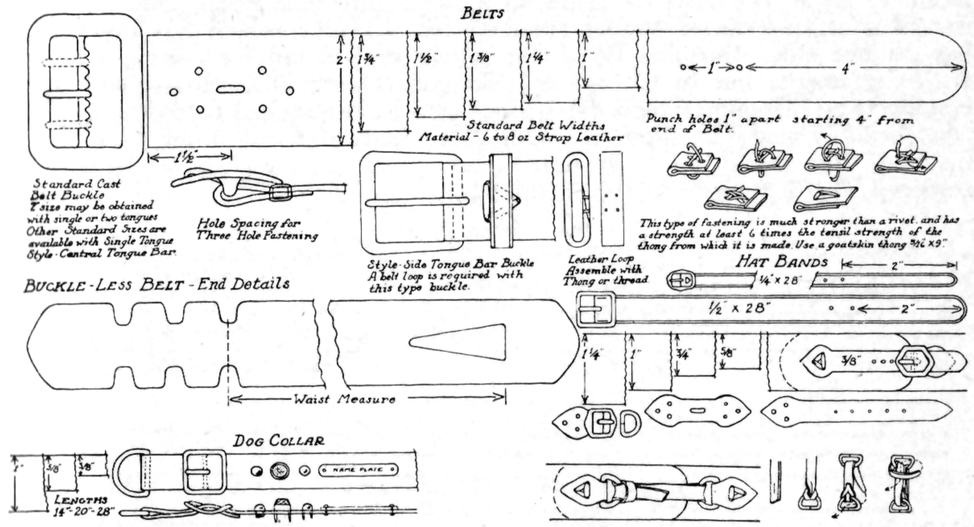
c. Apply the decoration and permit the belt to dry flat.

Polish the surface and edges, using a leather dressing.

d. If a dyed leather has been used, the final step before polishing is to stain the light edges.

e. Attach the buckle using the three hole fastening described on page 81.

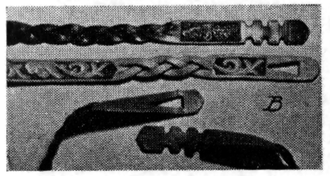
Belt widths, tongue details, buckle attachment with thong laced three hole fastening are indicated in the sketches below. See page 81 for three hole fastening details.



Hat band widths, methods of attaching the buckles or dees and the cinch type fastening are indicated. A large detail of the cinch type fastening is shown by sketches C1 to C5, Fig. 1, page 81.

Dog Collar widths and lengths, Dee and Buckle attachment detail are shown in the sketches. Dog collars are usually decorated with metal ornaments. See method of attaching ornaments shown on page 47.

The Buckleless Belt, end details are shown in the sketch and photograph. The construction of the three strand endless braiding is detailed on page 84.



A buckleless belt is shown in Photograph B. One end of the belt is shaped with three notches on each side. The other end contains a wedge shaped slit. Insert the notched end of the belt in the opening and rotate the two ends until the space between the notches rest against the end of the wedge shaped slit.

LEATHER CRAFTWORK

Wrist Watch Strap

Cordovan (Horsehide), Pigskin, Lightweight strap leather (cowhide) and Kip (Veal or Calfskin) are the leathers suitable for wrist watch straps. The Cordovan known as shell in the 2½ to 3 ounce weight is affected less by perspiration than any other leather.

Sketches series A1 to A4 show details of a double thickness strap, which may be assembled by sewing or edge laced with leather lacing. Sketches B1 to B8 show the detail of a single thickness strap. B4 shows the use of a strap loop or keeper required for a buckle which has the tongue bar on one side. Sketches B5 to B8 shows strap detail for use on a buckle with the tongue bar in the center. Sketches D1 to D 6 show detail for a concha type fastening which has a hook and loop attached to the under side. Sketches C5 and C6 show a metal plate pierced for a three hole thong fastening. A metal tube through which a spring pin fastener passes, is soldered (hard solder) to the metal plate.

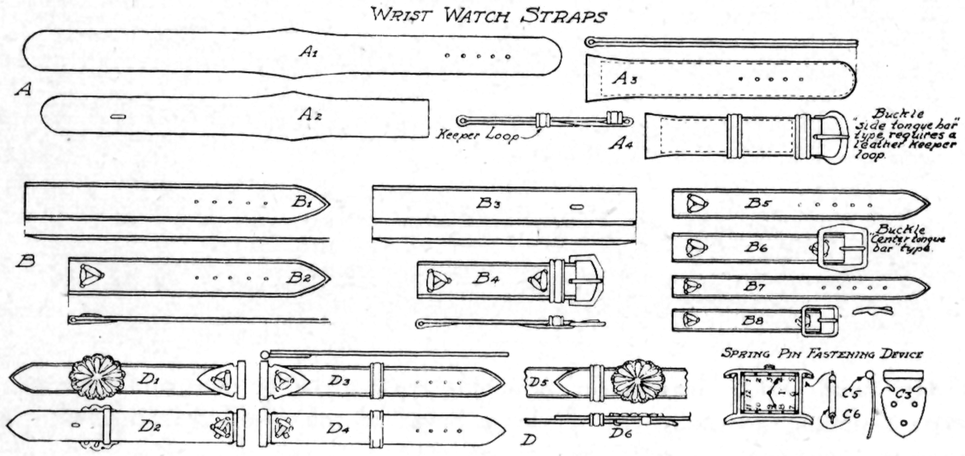
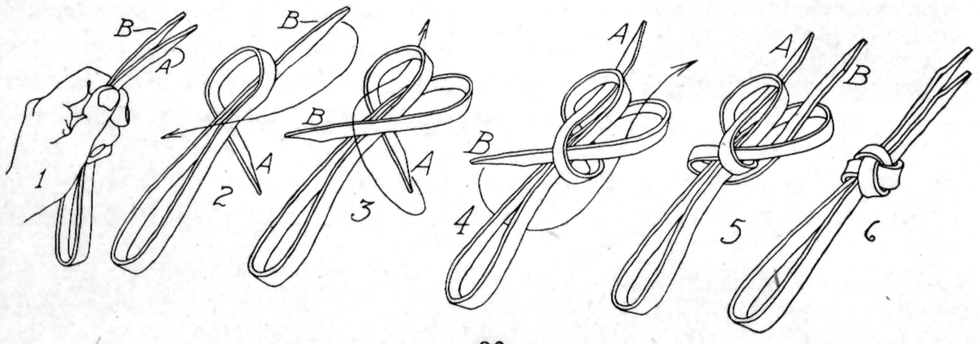


Fig. 3

Thong and Split Strap Attachments and Fastenings

The two strap turkshead is illustrated in the sketches 1 to 5. Sketch 1 shows the two straps A and B, flesh sides together. Sketch 2 shows strap A folded around strap B and the position strap B is to occupy. Sketch 3 shows strap B folded across strap A. Strap A is then brought around both straps and passes through its own loop as shown in Sketch 4. Strap B is also carried around both straps and passed through its own loop as indicated in Sketch 5. The turkshead is tied loosely, both ends are made of equal length, and the knot is pulled tight as shown in Sketch 6. This knot is used to join Bag Draw Strings or Camera Case straps, Quirt or other handle straps and Bridle Reins.



LEATHER CRAFTWORK

Attachments and Fastening Devices

The Three-Hole Thong Laced Fastening

The strap attachment detail given in Sketches A1 to A5, Fig. 1, is a primitive type of fastening. Saddle Cinch straps, Bridles and Reins, laced with a wet buckskin or rawhide thong were suitable for the most strenuous use. Several applications of this style of fastening are shown in Fig. 1.

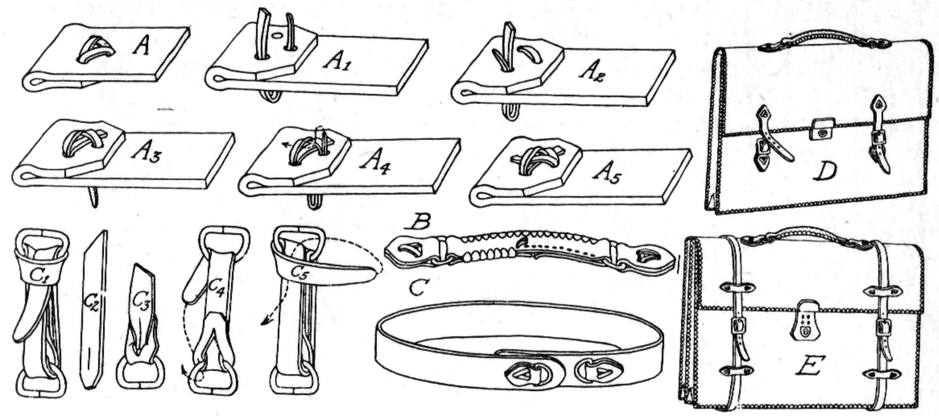


Fig. 1

Many other applications will suggest themselves. Purse handles may be attached in this way, either with a dee strap as the brief case handle in Sketch B, or laced directly to the purse. It is especially appropriate for attaching the double handles, of the long and short loop type, which otherwise must be machine stitched to the front and back of the bag or purse.

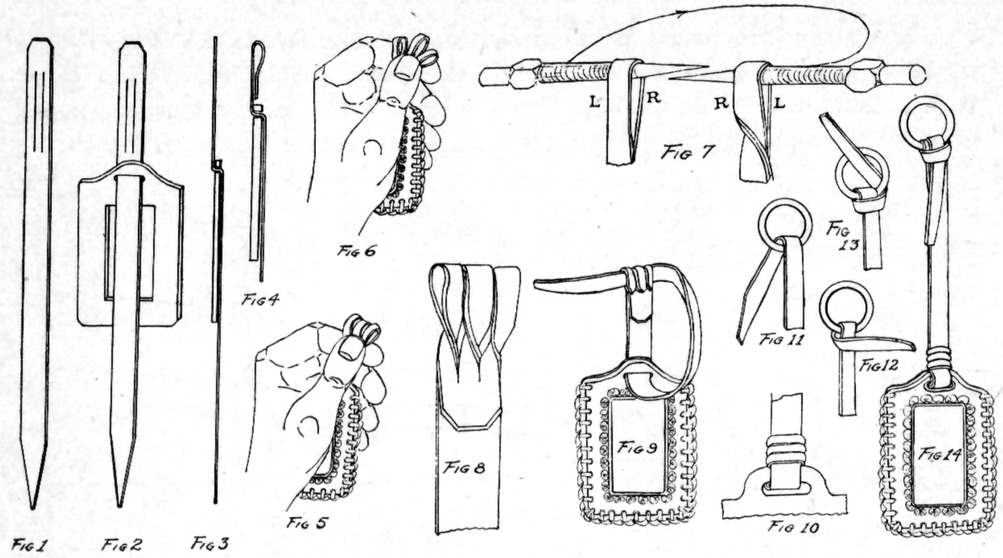
Bag Tag Strap

The method of fastening a strap to the bag is illustrated in Fig. 1 to 9 of the accompanying sketches. Fig. 1 shows the strap with two slits 1½" long near the plain end. Figs. 2 and 3 show the strap inserted through the hole in a bag tag.

The strap has the flesh or rough side up. Fold the end of the strap over as shown in Fig. 4. Separate the loops as shown in Figs. 5 and 6. Insert a marlin spike in each loop (as shown in Fig. 7) from the left and give it a twist as indicated in Fig. 7. Do this with each strap and the finished appearance will be as shown in Fig. 8. Then insert the tapered strap end in the loops as shown in Fig. 9. Pull up tight and the resulting appearance is that shown in Fig. 10. This will attach the strap to the bag tag.

The tag may be attached to a ring as shown in Figs. 11 to 14. The strap is placed throu h the ring (Fig. 11) looped over itself as shown in Fig. 12, passed through the ring as shown in Fig. 13 and down through the loop as shown in Fig. 14.

Attachments

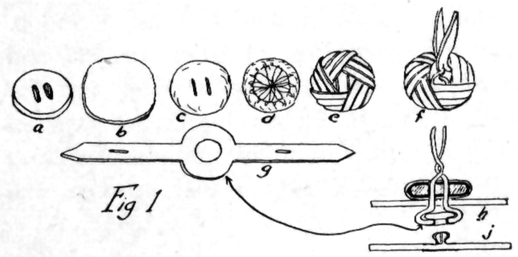


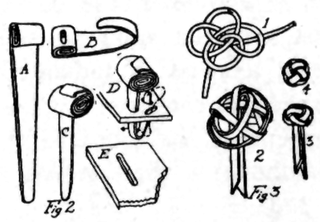
Button Suggestions

The Turkshead Button is shown in Fig. 1. Sketch "a" is a leather core —"b," cover—"c" and "d," cover attached—"e," covered core enclosed in thong Turkshead, see page 115 for method of making Turkshead. Sketches "g" and "h" show the application of the button to a garment with or without a snap fastener.

The Pioneer Button is shown in Fig. 2. Sketches A-B-C show the construction of the Button. Sketch D indicates a method of attachment and the relative position of the button and button hole.

The Crown Button is shown in Fig. 3. Sketch 1 indicates the construction detail. Sketch 2 shows the button cupped into shape and Sketch 3 shows the appearance after the slack is removed. Sketch 4 is the top view.

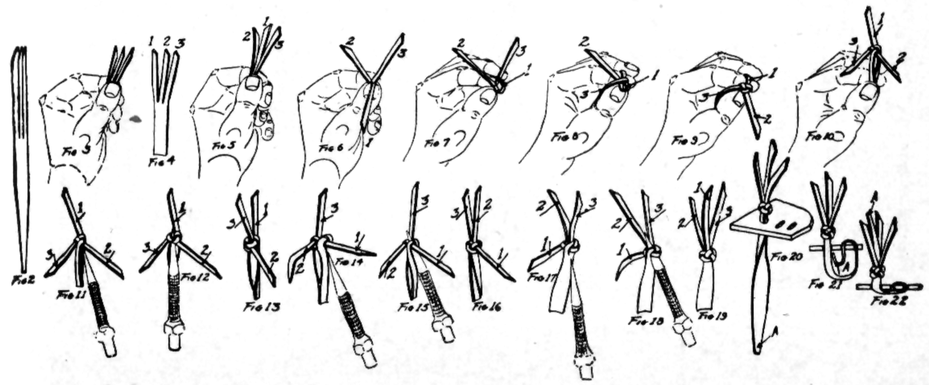




Terminal Turkshead Fastening

The terminal turks head fastening is useful in axe sheaths and camera cases for fastening the flap to the sheath or case. The method of preparing the strap, tying the terminal turkshead and applying the strap to the leather is illustrated in the accompanying sketches, Fig. 1 to 22.

The terminal turks head is the type of fastening which pioneers used for attaching the cover of pouches to the pouch itself before snaps and buckles were available. The method of making this type of fastening is illustrated in accompanying illustrations, (Figs. 1 to 22). Figs 1 and 2 show the method of splitting the end of the strap and tapering the end to a point. Figs. 3 and 4 show the method of numbering and holding the strap. Figure 5 and Figure 6 show preliminary steps in the formation of the crown knot. Figure 7 shows the formation of loop with strap 3 No. 1 by placing the end between straps 2 and 3. Fig. 8 shows strap 3 crossing over strap 1 and passing down between loop 1 and strap 2. Fig. 9 shows the finished crown made by inserting strap 2 in loop No. 1 after crossing over strap 3. Fig. 10 shows the appearance of the crown. The succeeding steps illustrated in Figs. 11 to 19 show the method of bringing each strap up through the center of the crown knot, taking them in their turn. For this operation, the marlin spike is needed to spread apart the crossed thongs of the crown to make room for each strap as it is brought around the crown support and under each protruding strap. See Figs. 11, 12 and 13 for the operation in placing strap 3 up through the center of the crown. Figs. 17, 18 and 19 show the operation for completing the terminal turks head by passing strap 1 around its support and up through the center of the crown. Figs. 20, 21 and 22 illustrates the method of attaching the terminal turks head strap to the leather. Three holes are punched in the leather. One should be circular through which the strap slips as shown in Fig. 20. The other two perforations need be only slits about the width of the strap itself. After tapering the end of the strap A, open up the slits with marlin spike and pass end A up through the outside slit down through the center slit and up through the round hole and out through the center of the crown of the terminal turks head as shown in Figs. 21 and 22. In Fig. 22, the end A is shown protruding through the center of the terminal turks head. When this is pulled up tight so that the turks head seats against the top of the leather, the appearance is as shown in Fig. 22. The greater the tension on the turks head and the end A, the tighter the fastening becomes. This terminal turks head is then buttoned through an opening in the flap of the axe sheath, camera case or other project where applied.



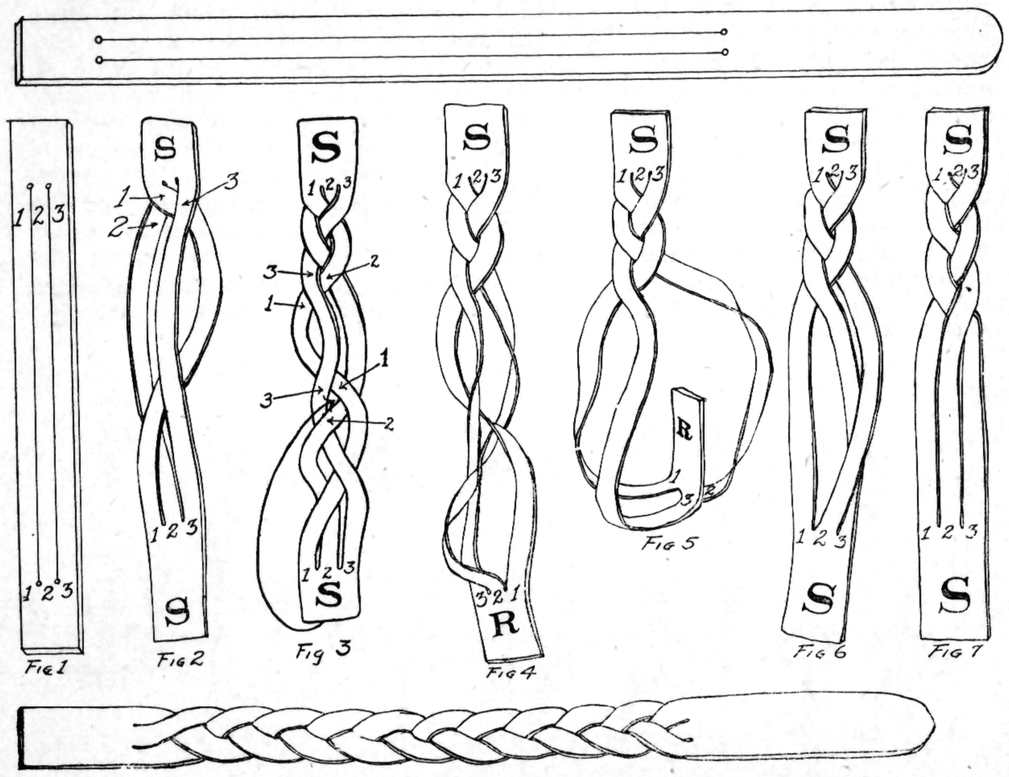
Strap Leather Project

Split Strap Braiding

The illustrations Figs. 1 to 7 show a method of braiding a split strap. Fig. 1 shows the strap with two slits in it. The straps made by slitting are numbered 1-2-3 from the left.

Start the braiding from the left by crossing strap 1 over 2 (step 1), and lay strap 3 over strap 1 (step 2) as shown in Fig. 2. Continue the braid, counting each strap crossing a step. Step 5 has been reached in Fig. 3. The next operation is to remove the tangle which has occurred in the other end of the leather. Refer to Fig. 3, you will note the strap still has the smooth side uppermost, as indicated by the letter S. Pass the lower end of the strap through the mesh formed by straps 1, 2, and 3, Fig. 3 from front to back. Pull the strap out straight as shown in Fig. 4. The upper end of the strap is smooth side out, and the lower end shows the under or reverse side. This removes part of the tangle. Step 6. Lay the right hand strap over the center strap. In Fig. 3 strap 2 crosses strap 3. It now remains to remove the rest of the tangle. Pass the lower end through between the right hand pair of straps from front to back as shown in Fig. 5. This operation straightens out the strap, and brings it into position to continue the braiding. Continue the braiding until the split ends become too short for pulling through the mesh to straighten out the tangles. This will leave a space of 2½ to 3″ that is unbraided. This space is filled by lengthening out the braided section until it completely occupies the split portion of the strap and has a uniform appearance.

Besides the braiding of belts, this system of braiding may be applied to various other straps. Camera case strap, Bridle reins, handles for bags, and wrist watch straps may also be split.



Strap Leather Projects

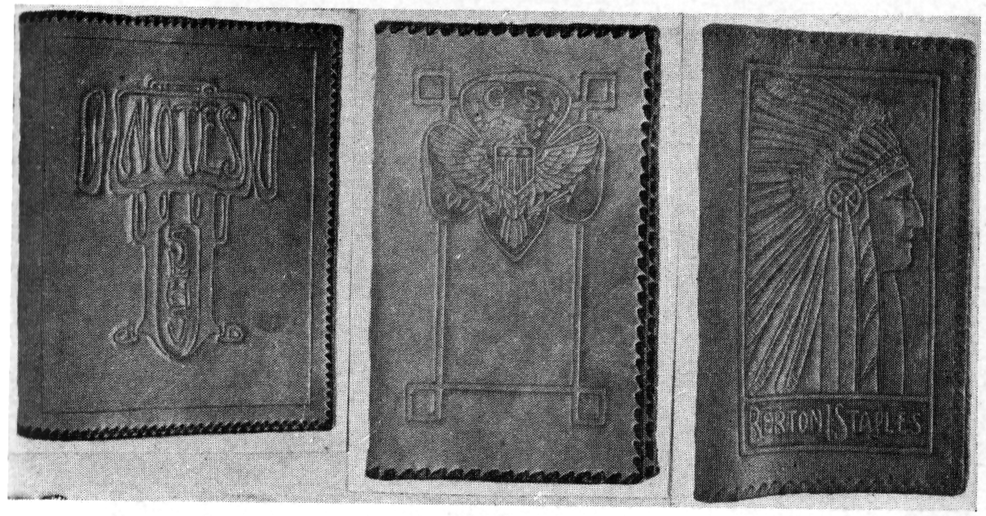
Note Book Covers may be made of 4 oz. cowhide, tooling vealskin, or tooling steer. Unlined Cowhide may be used with the rivet type note book metal. Other leathers should be lined. The illustration shows left to right: 4 oz. Cowhide with tooled decoration, Vealskin, with Girl Scout emblem tooled and Steerhide, also tooled.

a. After the decoration is applied the outside piece should be folded before it is dry so that it will be flat. A fold of paper or cardboard about the size of the note book leaves may be placed between the covers until the leather dries.

b. Attach the metal to the cowhide with rivets or clips inserted in base plate metal.

c. Assemble with wide lacing starting near the top of a pocket.

Note Book Covers



Brief Case

A Brief Case may be constructed as an advanced project. 4 and 6 oz. cowhide should be used according to the size selected. The illustration on page 86 shows a simple stamped panel design. Monograms or metal letters may be applied to the flap panel if desired. Stamping and carving detail is described on pages 45-46-47.

a. Bevel the edges, dampen, crease and decorate. Allow to dry with the flap folded in the correct position.

b. Attach the handle, buckle straps and fastening plate. (the catch is attached after lacing) as instructed on page 86.

c. Lace the flap first, using wide lacing. Start the thong through from the underside at the middle point. Pull through to the center of the thong and lace toward the corners so that the direction of the lacing is the same both ways. Leave sufficient thong to conceal ends in the gusset lacing later.

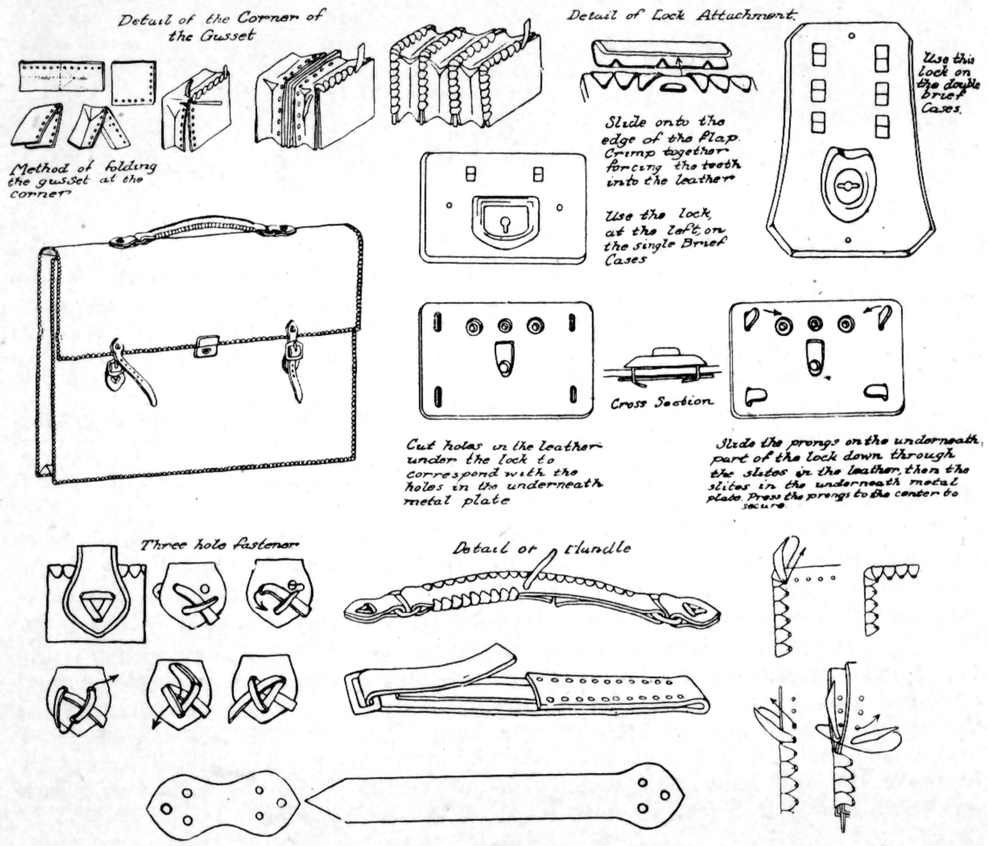
d. Locate the center of the gusset strip, punch about four holes, using the same spacing as in the back of the brief case, tie in position and continue punching toward the corners. Compare spacing occasionally as the softer gusset may stretch in punching. Estimate the hole spacing for about one inch from the corners and increase spacing slightly if necessary to make the end hole come exactly in the corner. Fold the gusset and lace as shown in Fig. 2, Sketches A to E, page 53, also page 86.

Brief Case

e. Lace the front or pocket to the gusset in the same way.

f. Apply leather dressing and polish as directed.

Music cases may be made in the same manner as the brief case, or a single pocket music case is satisfactorily made with the curved gusset as in camera cases.



Carved Veal Skin Folding Coin Purse

A popular type of gusset purse which is an adaptation of the English stitched coin purse is assembled as detailed in the Sketches 4 to 23. The application of a carved decoration to this purse is shown on page 88, Sketch 22. A suitable stamped decoration is shown in Sketch 23, page 88.

1. Trace the design on the leather which has been evenly moistened.

2. Score or incise the outline with a Swivel Cutter, as indicated in Fig. 2.

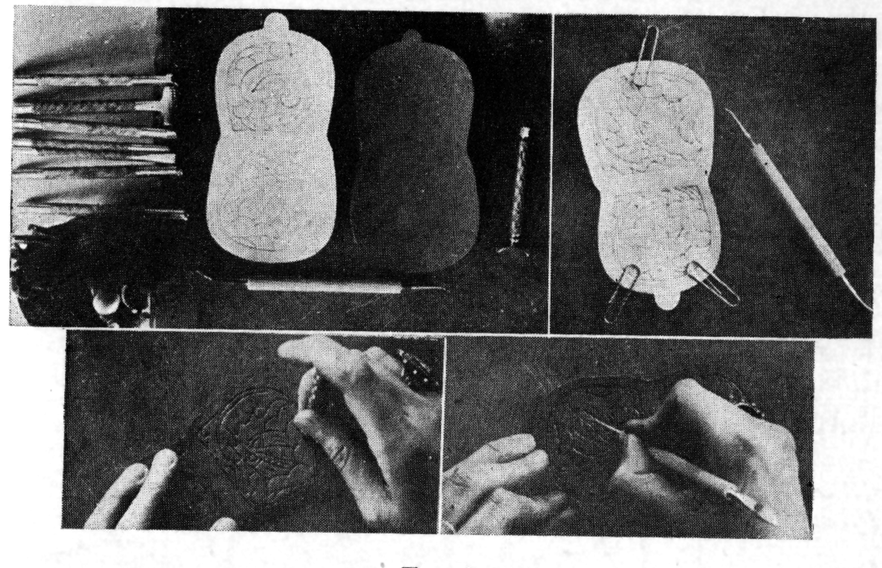


Fig. 2

3. Open the incised lines by spreading them apart with the tip of a modeling tool as indicated in Fig. 2.

4. Hammer down the background around the design with a round pebble dot background tool using a rawhide covered striking stick or hard wood mallet.

5. Depress all edges which show overlapping with a modeling tool or a beveling tool. See No. 52, Fig. 13.

6. Apply the scallop shaped tools, see 61, 62, 63, Fig. 13, page 43.

7. Apply the horseshoe shaped tools, Nos. 58, 59 and 60, as indicated.

8. Apply the oval depression tools. No. 54, 55, 56 along the floral outlines to give relief to plain areas.

Purse parts numbered 7 and 8, the upper and lower parts of the coin compartment, are shown superimposed to indicate their relative position and the punching specifications. Sketch 9 shows the procedure in skiving the upper edge of part 8. Sketch 10 shows the thin edge folded over and ready to be cemented. This practice is recommended to overcome a "raw edge" across the top of this coin purse.

Lacing Procedure

Start at the middle point of each gusset, parts 5 and 6 and lace the edges to part 4. Gusset number 5, with center point marked O should be

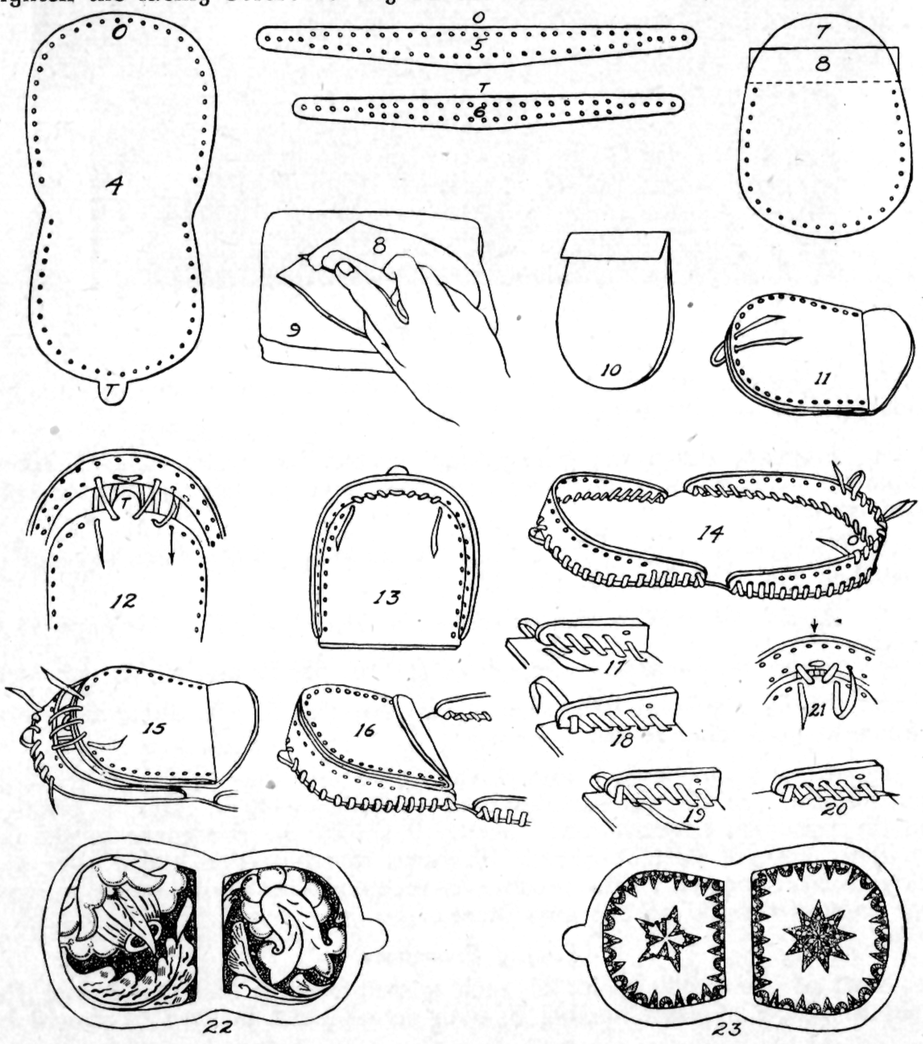
Assembly—Coin Purse

laced to the purse, part 4, starting at point O. Gusset No. 6 with center point marked T should be laced to the part 4 starting at the point T. See Sketch 12 which shows the method of joining gusset 6 to purse, part 4. Note the lacing thong is passed through the two center points of the gusset 6 and each end of the lacing is carried forward, using the whip stitch, see Sketch B, page 59. One end of the lacing thongs moves to the right while the other moves to the left. Gusset 5 is attached to part 4 in a similar manner.

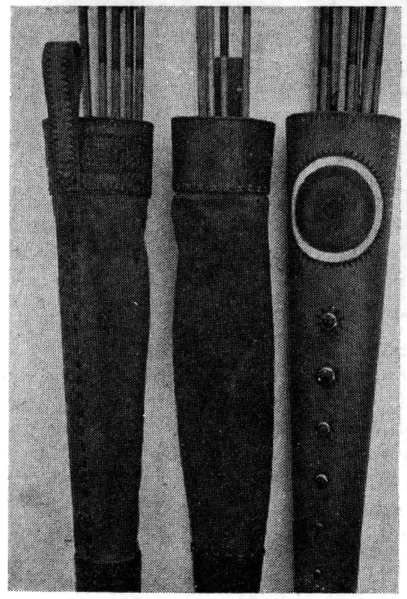
Lace the parts 7 and 8 to the upper edge of gusset 6 as indicated by Sketch 15. Start the lacing as indicated by Sketch 11. End the lacing as shown in Sketch 17 to 20.

Lace the upper edge of gusset 5 as indicated in Sketch 14. Two short lacings may be used and the ends left protruding to serve as a finger hold opposite the tab T, Sketch 3. These two extensions are a convenience in opening the purse.

End the lacing at the gusset tip as shown in Sketch No. 17 to 20. Pass the lacing through the last hole in the gusset twice as indicated in Sketch 18 and carry the end under three or four loops, as shown in Sketch 20. Tighten the lacing before cutting off the end.

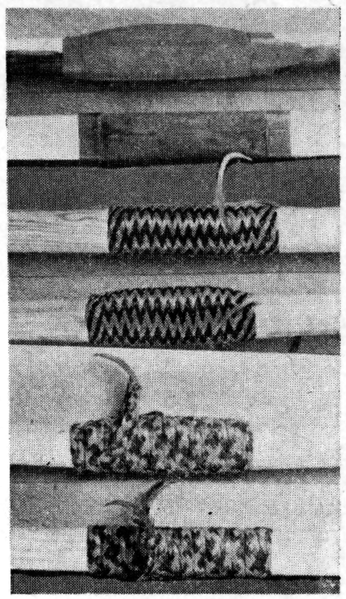


Archery Equipment—Quivers



1 2

3



4

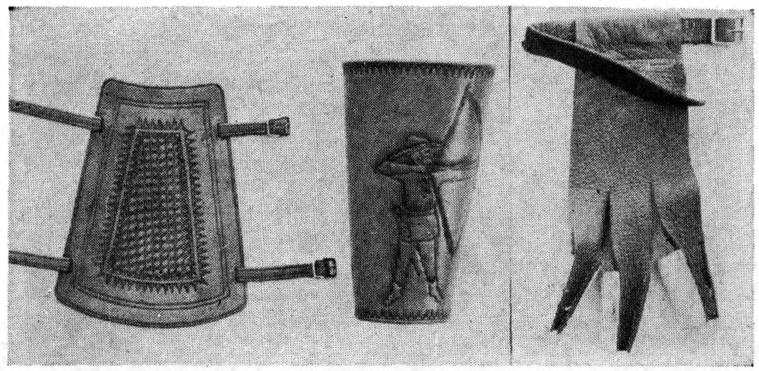
No. 1 shows a quiver with top and bottom of strap leather. These are lapped and laced to the split center and the body thus formed is joined and laced to the strap bottom as described on page 54. No. 2 is an all strap quiver. No. 3 is a flat type quiver with the bottom turned back. It is cross laced as shown in Fig. 3, Sketches G-H-I, page 54.

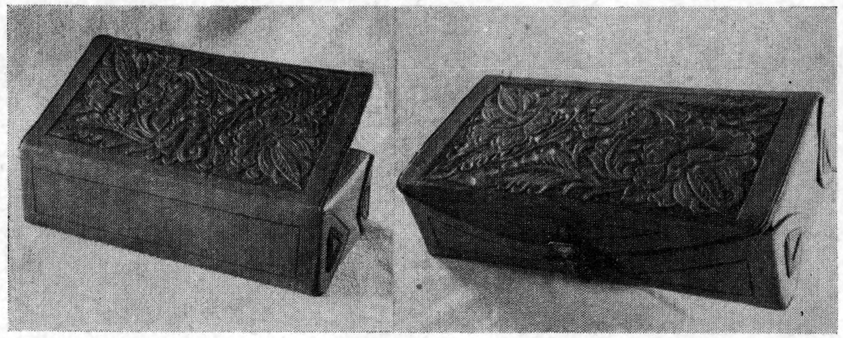
Bow Grip Suggestions

Three types of Bow Grips are illustrated. The upper one is made of Split Cowhide, cemented to the handle with the junction extending along the back of the Bow. Above and below the split grip, strips of colored leather are cemented. The upper strip is shaped to form an arrow plate.

The grip shown in the photograph, is made from a strand of 4 plait flat that has been woven around the grip. Use thongs cut from four 3″ discs.

Army Guards and Shooting Glove





LEATHER BOXES

Waxed Thread Assembly—Hand Sewn Box

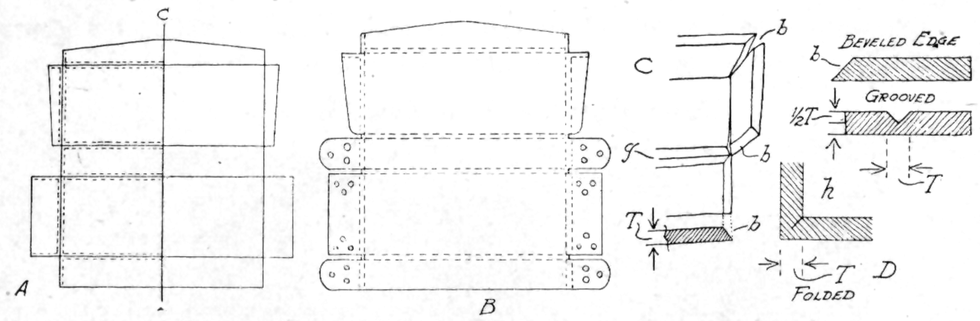
Leather Boxes may be made of 8 ounce cowhide and light weight saddle skirting. Two types of assembly are shown. In style A all box corners are assembled by hand sewing. In style B the corners of the lid only are sewn by hand and the box is assembled by means of the three hole fastening device, detailed on page 81. The box pattern outline of the pattern for style A box is shown in Sketch A and that for the style B box in Sketch B.

In style A box all joined corners are mitered at the points marked (b) as indicated in Sketch C. All folded corners, marked (g) in sketches C and D are grooved as shown in Sketch D. The groove depth is ½ and its width equal to the thickness of the leather.

Assembly Procedure.

1. Lay out the pattern to conform to the leather thickness (allow a margin, equal to the thickness of the leather, for the folds as shown in Sketch D.) Cut the leather to pattern outlines. Crease edges to be sewn. Cut the grooves and bevel the edges as shown in the sketch, taking great care not to cut too deep—not more than one-half the thickness of the leather —and bevel back only the distance equal to the thickness of the leather. Also bevel the inside edges which are to be sewn.

2. Decorate the panels as desired, with a creased, stamped or carved design.



3. Mark the hole spacing, 6 stiches per inch are recommended. The overstitch finishing wheel, Sketch E, can be used both as a marker and for finishing stitches. Pierce holes along creased lines at the points marked, with a harness maker's awl as indicated in Sketch F. Place a soft pine board under the leather.

4. Wet the leather by immersion (avoid saturation to the point of oozing), and form it while wet over a wooden block as shown in Sketch G.

Waxed Thread Assembly—Hand Sewn Box

Allow to partially dry before sewing, which is done on the wooden block.

5. Sew with waxed thread (method of waxing thread shown in sketch), using two needles as indicated in sketches J to N, and shape the stitches with the overstitch finishing wheel. See Sketch N.

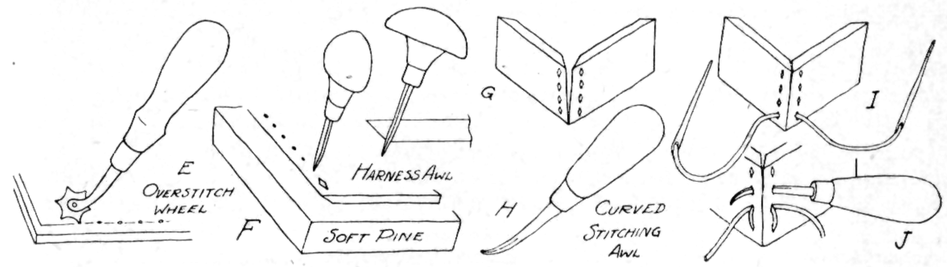
6. Attach catch, cut slits to receive prongs. Bend prongs over back plate.

7. Apply burnishing stain to the edges and leather dressing to all surfaces.

8. The finished box may be lined with leather skiver, velvet or a water proof oiled silk.

Suggested Tools and Accessories

1. Wooden block, size of inside dimensions of box No. 2.
2. Rocker knife for cutting saddle skirting—use on end grain soft wood block or sugar pine board.
3. Incising knife and skiving knife.
4. Overstitch wheel, 6 stitches per inch.

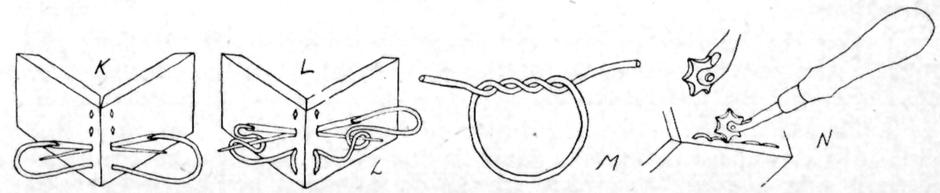


5. Harness awl and curved stitching awl.
6. Harness needles, size No. 5 or No. 6, and Barbours No. 12 linen thread Wax.
7. Edge beveler and wood creaser. Tools as required for decoration.
8. Edge burnishing ink or stain and leather dressing.
9. Catch and lining material.

Sewing with Two Needles

1. Start at the lower corner of the box. Sketch H. With a needle at each end of the thread pull it to the middle point. Pass the needles through the next hole above as indicated in Sketch J and pull both ends taut. This procedure forms the plain stitch. The use of a curved awl to open up the holes is shown in Sketch K.

2. The formation of a locked stitch is indicated in Sketch L. This is accomplished by taking one turn with the loop of thread around each needle before pulling the needle through and the ends taut. The direction of the turn which is made around the right hand needle is clockwise, while the direction of that around the left hand needle is counter-clockwise. The detail of the locked stitch is indicated in Sketch M. Shape the stitches with the finishing wheel as shown in Sketch N.

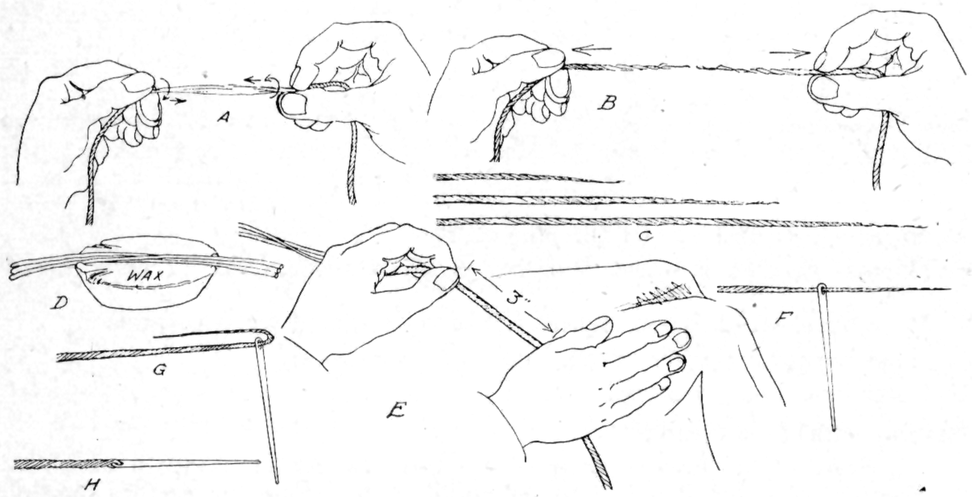


LEATHER PROJECTS

Making Waxed Thread

1. Pull out from the ball a length of about 6 feet of No. 12 Barbours Linen Thread. Untwist without tension for a space of about 3 inches, holding as indicated in Sketch A. Note that the fibers are released and enlarged in diameter. Give the untwisted strand a quick jerk to separate the fibers and pull gently about 2 inches into elongated and tapered points as shown in Sketch B. Repeat this operation for three or more strands according to the strength of thread desired.

2. Make a three or four ply strand with the lengths of tapered thread placed with the ends spaced about an inch and one-half apart as indicated. Wax the strand into a ribbon as shown in Sketch D. The spacing of the ends permits a papered point for insertion into the eye of the needle. Roll the waxed ribbon into a round thread, saddlers method, by rolling it on the thigh with slight tension to prevent kinking. With one end in the left hand roll the strands with the palm of the right hand, taking successive lengths of about 3 inches at a time. Sketch E. A palm's length roll puts 15 to 20 twists per inch in the 3 inch sections of a three strand thread. Attach the harness needle to the waxed thread as indicated in Sketches F, G, H.



Moccasin, Canadian Pac Type

Tool List: Punch, Drive or Spring Type. Edge Creaser, Saddler's Stitching Awl 1¾″ to 2″ length. No. 12 Barbours Linen Thread. Wax, two No. 3 Harness Needles—blunt; Curved Sewing Awl, Rocker Knift, Skiving Knife. Wooden Foot Form ¾″ to 1⅛″ thick. Patterns Part A and B.

Materials: Strap Leather 10 oz., or light weight saddle skirting. Outer Soles; Soles; Heavy Chrome Tanned Leather or Commercial Rubber Fabric Soles.

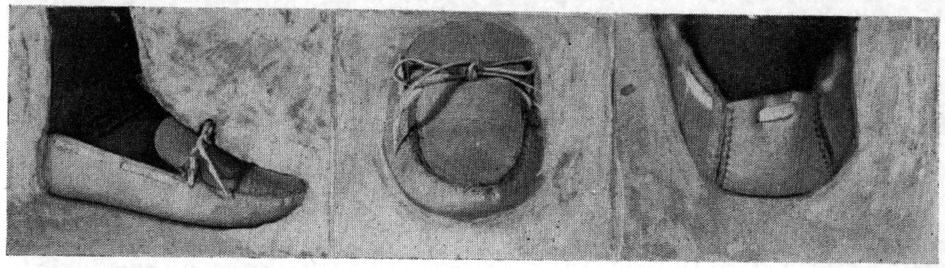
Instructions:

1. **Cut the Leather** to size and shape of pattern parts, A vamp and B tongue. The pattern shown is for the right foot. Turn the pattern over to cut leather for the left moccasin.

2. **Crease** a line on the grain side of the leather ⅛″ from the edge to guide in piercing aw l holes. Crease a line about 3/32″ from the edge on the flesh side of both vamp and tongue as indicated in Sketch E.

LEATHER PROJECTS

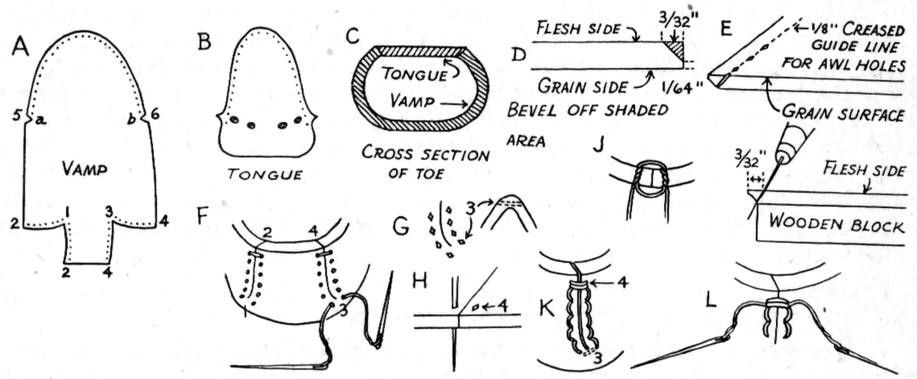
Hand Sewn Moccasin



3. **Skive the Edges** of the vamp and tongue between points a and b as shown in Sketches A and B. Also skive the edges of both heel seams, ½ and ¾. All edges to be skived are shown on the pattern as shaded margins. Slightly moisten with water before skiving. Refer to general leather working procedure, page 41-42.

4. **Pierce the Holes** for the toe and heel seams as indicated on the pattern following carefully the spacing shown. See Sketch E for method of piercing a skived edge.

5. **Sew the Heel Seams.** Moisten the edges to be sewn by dipping quickly in and out of water. Begin sewing at points 1 and 3. To facilitate sewing tie both points 2 and 4 together and start sewing as indicated in Sketch F. The first stitch is taken through holes pierced below points 1 and 3. See Sketch G. The awl does not penetrate the leather. Rather the leather is folded and the awl pierces the fold as indicated in Sketch G.



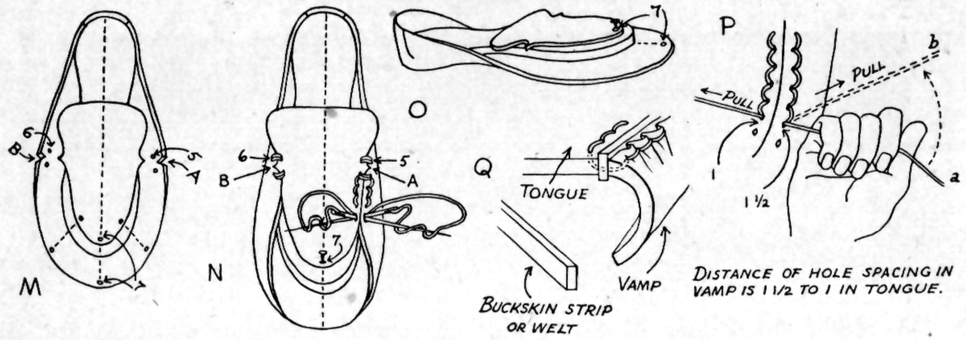
Moccasin—Pattern Development

Insert one of the two needles in this hole and pull the thread to its middle point. Use the locked harness stitch described on page 91. Open the pierced holes with the curved awl before inserting the needles. The locked stitch is formed by wrapping the thread around each needle as shown in Sketch F. Fasten the thread at the top of the seam by forming two transverse locked stitches across the seam. See Sketches H and J for method of making this transverse stitch. Finish both heel seams before starting the toe seams.

6. **Sew the Moccasin Toe Seam**

a. Wet the vamp (part A), by soaking it in water. The edges of the vamp must be sufficiently pliable to permit compresssing between the holes. Wet the tongue (part B), slightly by dipping it quickly in the water. The edges of the tongue must be almost dry, quite stiff, and firm enough to support the compressed edge of the vamp without stretching.

Hand Sewn Moccasin



b. Place the wooden foot form on the vamp with the heel contacting the leather. Shape the moist leather, cupping it around the curves of the foot form.

c. Place the tongue on the wooden form in the position shown in Sketch M, and bring the V notches in the vamp into contact with points A and B by shaping it over the form as indicated in the Sketch. Sew the vamp and tongue together with two transverse locked harnress stitches on each side of V notch A. Remove the wooden form and sew the opposite points together on each side of V notch B with the same locked stitch. Replace the wooden form and press it firmly against the moccasin heel. Stretch the vamp and tongue along the foot form and drive a small nail through the hole in the end of the tongue at point 7. See Sketches M and O. Proceed with the sewing along edge 5 to 7, using the locked harness stotch as shown in Sketch N.

As the vamp edge must be compressed to fit the tongue, the spacing of the holes in the vamp is one and one half times that of the tongue, and the stitches are uniformly tightened to pull the fullness into position as the sewing progresses. This is accomplished by keeping both threads in tension while the stitch is being drawn taut. The edge of the vamp must be wet enough to permit a slight folding under the compressive force of the thread as the stitch shortens. This equalization of stitch length is achieved by moving the hand from position a to b, Sketch P, as the final pull is exerted on the thread. The preceding stitches indicate the appearance of the compressed vamp edge.

Continue the process on around the toe to point B and secure the thread as described for point 4 of the heel seam.

7. **Remove the Foot Form (last),** and **punch the holes for the ankle thong** as indicated on the pattern, unless an upper is to be attached. In this case omit the hole punching.

8. **Insert Ankle Thong.** Shape the moist moccasin to the foot and either dry it on the foot or fill with crushed newspapers to retain the desired form, and dry over night.

9. **Apply Leather Dressing** to the outer surface of the moccasin. and colorless burnishing wax to all edges. Polish when dry with a cloth. This treatment is recommended for moccasins to be used indoors. This dressing preserves the light russet or natural color.

Moccasins to be used for **outdoor wear should be oiled.** Any water proof boot oil is satisfactory. Neats foot oil is excellent. As a precaution to **insure water tight seams,** a piece of soft smoked buckskin strap may be inserted as a welt between the edges of the tongue and vamp during the sewing operation as indicated in Sketch Q. This strip of buckskin fills the space and being absorbent may be impregnated with water proof oil or wax, thereby rendering the seam water repellant.

Moccasin Pattern Design

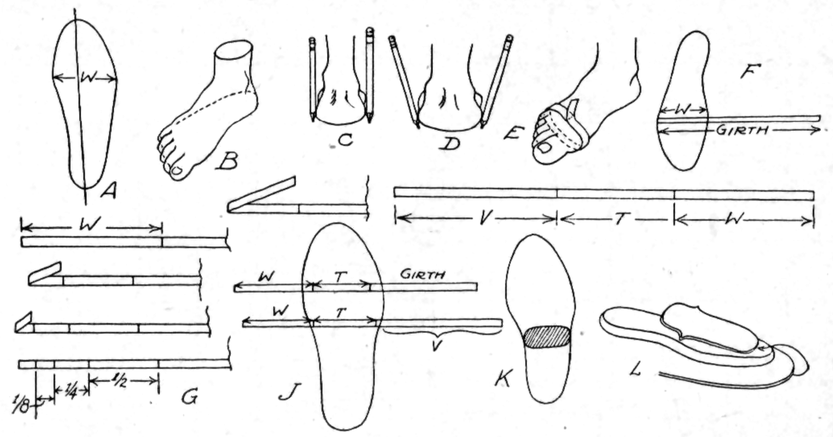
This procedure for developing a moccasin pattern has been developed from foot measurements. The craftsman should be able to plan a pattern to fit any foot measurements taken, as will be described.

The assembly instructions will yield a comfortable moccasin with the desired "tailor made appearance" characteristic of a well designed article constructed from suitable material. The detail for making an upper which may be attached to this moccasin is given on page 97.

Tools: Pencil, Heavy Paper, Scissors, Pine Board, ¾" for foot forms, Ruler.

Instruction:

1. Make a straight line on a piece of paper about two inches longer than the foot length. Place the bare or stockinged foot on this line which extends beyond the heel and toes, Sketch A. Center the heel on this line. Position the foot to bring the second toe directly over the line, Sketch B.



2. Mark the foot outline with a lead pencil. Keep the pencil in a vertical position and mark a complete outline as indicated in Sketch C. The second line marked with the pencil held in the position shown in Sketch D, reduces the original foot outline to conform to a shoe last size from which the wooden moccasin form is constructed. Correct any irregularities in curvature after removing the foot.

3. Take a girth measurement at the ball of the foot (widest part), as indicated in Sketch E. This measurement does not need to be reduced to units of an inch or fractions thereof, and may be taken with a strip of paper as indicated in Sketch E. Mark the length W (width of foot outline at ball) on the paper, Sketch F. Divide W into lengths of ½, ¼ and ⅛ by folding the end back on the paper strip as shown in Sketch G. This sub-divided length, W, is the unit of measurement which will be used to develop the tongue and vamp patterns.

4. Develop the Tongue Pattern, No. II

a. Redraw the foot outline as shown in the Sketch of pattern, part No. II. Mark the vertical line (toe to heel), also the horizontal line (through the ball of the foot), in their proper position. At the point of intersection, lay off the tongue length, ¾W above and ¾W below the horizontal line. Lay off ¼W to the left of the vertical line and ½W to the right. This determines the location of points I and O. The distance between is the tongue width.

b. Draw another horizontal line ¼W below line I-O, sketch of part II. Locate point A where the line intersects the foot outline, and lay off a length of ⅞W to the right of point A. This locates point B. The length A-B is the tongue width at the notches or instep.

Moccasin Pattern Design

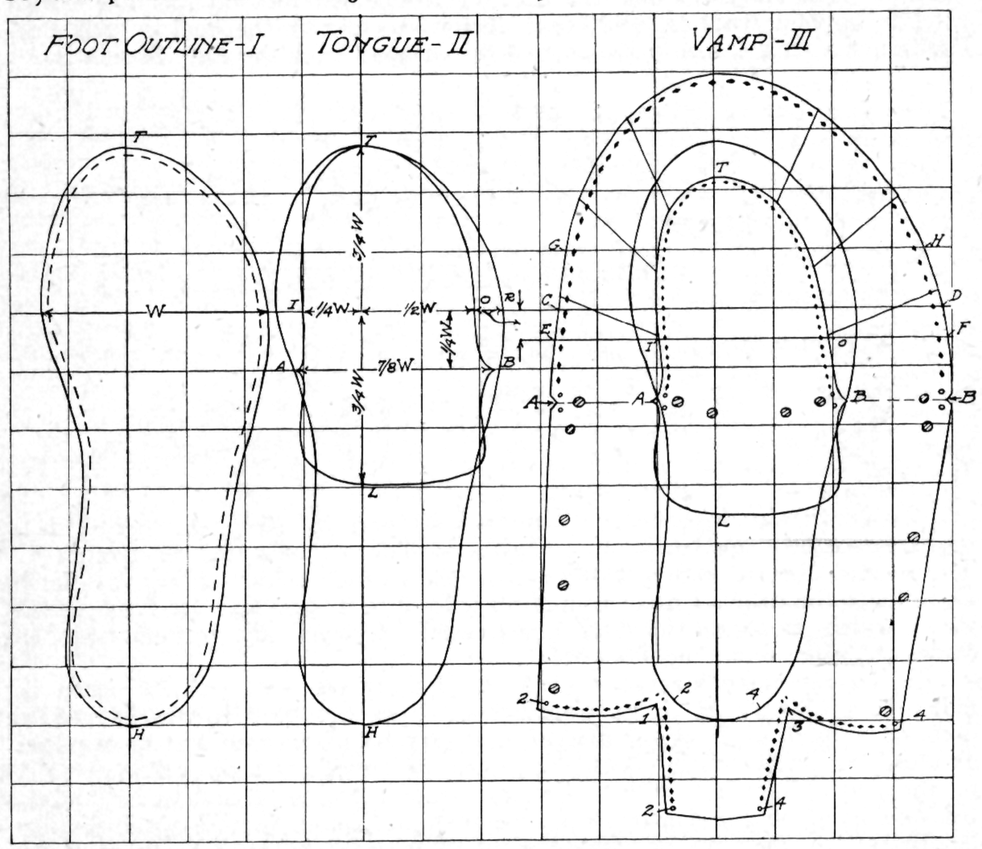
c. Cut a paper pattern of the tongue. The six points I-L, I-O, and A-B define the length and width for the tongue pattern. Sketch pattern free hand.

5. Develop the Vamp Pattern, Part No. III.

a. Redraw the foot outline, with the vertical and horizontal C-D lines shown in the sketch, part III.

b. Draw another horizontal line E-F across the foot outline the distance O-R below C-D. O-R is the distance between the tongue, Sketch II, and the foot outline. Slide the tongue pattern along the vertical line T-H until line I-O rests upon the line E-F.

c. Draw the outline of tongue pattern in the new position and another horizontal line through points A-B. Extend this line a couple of inches beyond points A-B. Ruling—One inch squares. Moccasin Size 6.



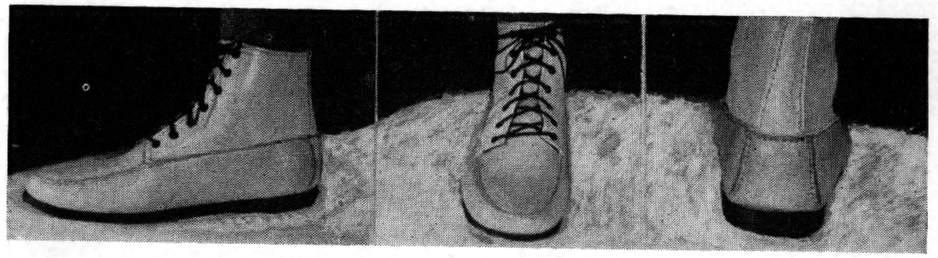
d. Determine the width of the vamp by measuring the girth of the foot on a strip of paper through points A-B. Since the girth measurement, G, includes the width of the foot outline W and the width of the tongue, T, (Sketch J, page 95) these two lengths must be subtracted from G. This is indicated in Sketch J. The remaining length V, Sketch J, is added to the width of the foot outline at this point to give width of vamp, line A-B.

e. Add one-half of the length V to each side of the foot outline on the line A-B. This locates the points on the vamp marked A-B where the notches are cut to receive the corresponding points on the tongue f. Locate points C-D, and G-H on the vamp by a similar procedure, using girth measurement less foot outline and tongue width.

g. Make a Wooden Form. This may be band sawn or cut by hand with a fret saw. (a) Make a paper pattern corresponding to the last form, outline Sketch C. Cut the form from a piece of $\frac{3}{4}$" wood (pine). Round the edges as shown in Sketch K, page 95.

Moccasin Upper

Foot wear as serviceable as any shoe may be constructed by adding an upper to the moccasin assembly detailed in the foregoing paragraphs. The photograph shows the appearance of the moccasin with an upper attached.



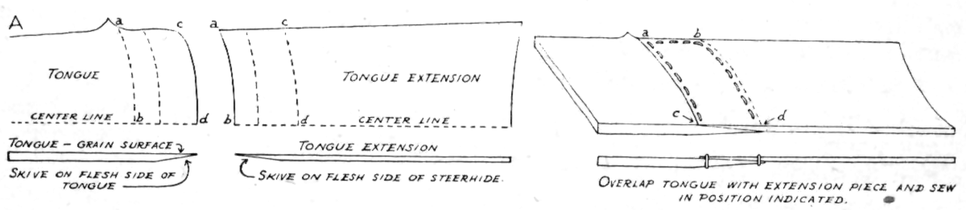
Tools: Same as listed for the moccasin project, also a punch and a shoe eyelet setting tool. Rubber Cement, Marking Wheel and Wooden Mallet. Patterns for parts A, B, C, D, E.

Materials: Make the upper from Russet Steerhide $2\frac{1}{2}$ to 3 ounce weight.

Instruction:

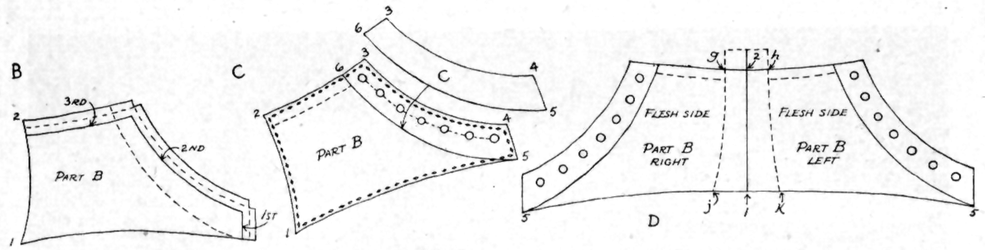
1. Cut two pieces of steerhide from the pattern, part A, tongue extension, one for right and one left. Skive a $\frac{1}{2}$" scarf from line a-b to the edge on the flesh side of the steerhide. See Sketch A. Also Skive the edge c-d on the moccasin tongue. This should be done before the moccasin is assembled. Cement the tongue extension to the top of the moccasin tongue overlapping the area a-b over c-d. Sew as indicated bv the line of stitches shown in the sketch, using the plain harness stitch with two needles.

2. Cut four pieces of steerhide from pattern, part B, reversing for two each left and right. Skive the edges as indicated by the shaded areas. Cement and fold along dotted lines; first, second and third folds as indicated in Sketch B. Hammer the edges lightly with a wooden mallet to bond the turned edge. Cement four reinforcing strips of steerhide, part C, indicated by the shape 3-4-5-6, Sketch D, to part B. Crease and prick mark with the

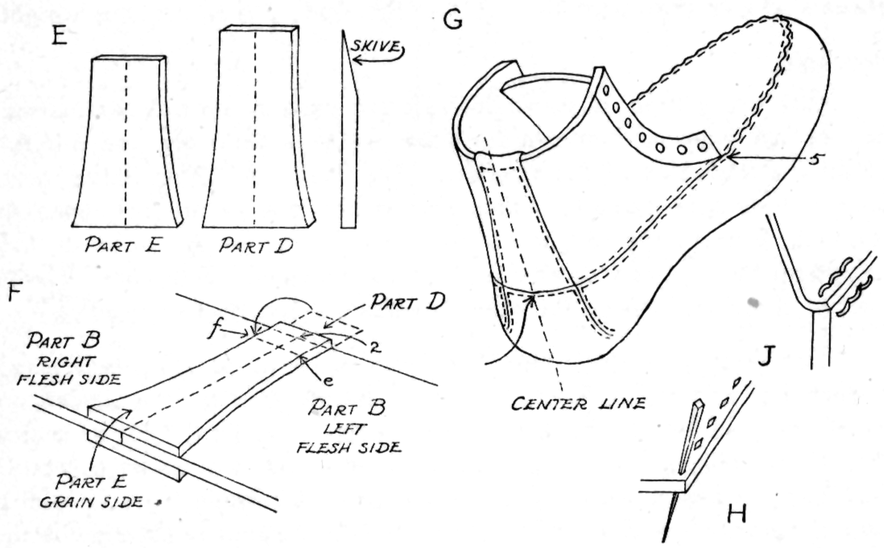


Moccasin Upper

stitching wheel (6 stitches per inch), the position of the awl holes along edges 2-3, 3-4, 4-5. Pierce and sew with the plain harness stitch, using two needles. See instruction for waxed thread making, also detail of the plain and locked stitch, pages 92 and 95. Crease and prick mark the awl hole positions along edges 1-2, and 1-5. Punch holes for lacing and sew eyelets as shown in Sketch C.



3. **Cut two pieces of steerhide** acording to patterns for parts D and E. Skive the top of part D, cutting a scarf ¼″ wide. Mark the center line CL on the besh side. Apply rubber cement to the flesh surface, part D. Place a left and a right of part B, flesh side up, upon part D, with edges ½ in contact on the center line as shown in Sketch E. Apply cement to the flesh side of part E and press it upon the flesh side of the parts B to cover joint 1-2, Sketch F



Apply cement to the end of part D, fold it over the upper edge of part E and attach along the line c-f. See Sketch F. Sew the cemented parts together along edges g-h, h-k, k-j, j-q, with waxed thread, using the plain harness stitch. See Sketch E.

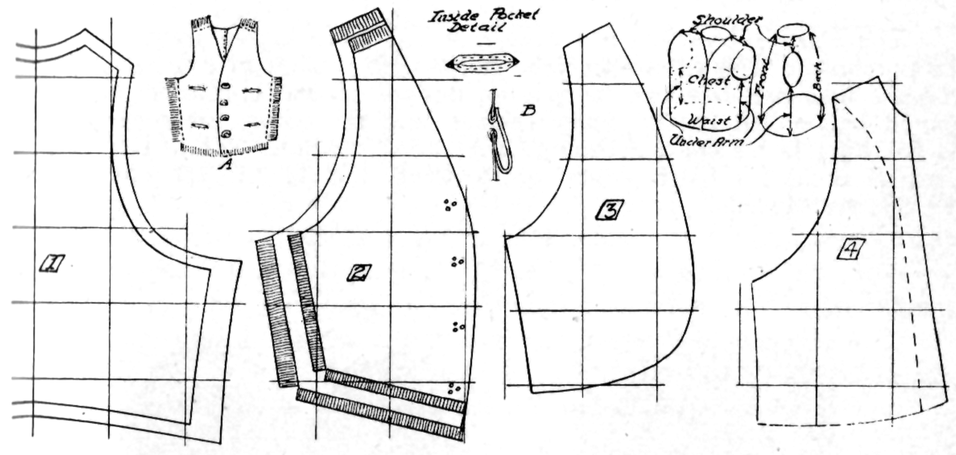
4. **Attach the Assembled Upper** to the moccasin.

Crease a guide line along the upper edge of the vamp ⅛″ wide. Prick mark position of the awl holes, 6 per inch, and pierce as detailed in moccasin vamp assembly, Sketch E, page 93.

Place the center line of the heel seam of the upper in line with the centerline of the moccasin heel, Sketch G. Sew from point 1 to 5 on each side, using the locked harness stitch.

Soft Leather Vests

The patterns shown are drawn to scale and may be constructed in actual size by redrawing the outlines on paper ruled with 4″ squares. One half of the back pattern is shown in Sketch No. 1. Two sizes of vests are shown, a 34″ and a 40″ (chest measure). The back pattern may be used with any of the three styles of front patterns indicated. It is recommended that the pattern be constructed to fit the individual from actual measurements of chest, waist, length of front and back, under arm and shoulder. Add fringe margins to the measurements as indicated on pattern.



Assembly is shown in Sketch A with front shoulder, and under arm seams lapped over back and the stitching lines indicated. The seams may be machine stitched, hand sewn with waxed thread or laced with a leather thong. Attach rolled leather buttons, see the construction and attachment detail, shown on page 79. Cut fringe with a sharp knife on a soft pine block. This pattern may be modified to make a Bolero or Gaucho style by omitting fringe margin and cutting fronts to shape indicated. The use of pockets is optional. Inside or outside patch type pockets are useful and decorative. A slide fastener may be used instead of buttons or snap fasteners. Insert tape of fastener between edge of vest leather and the facing as shown in pattern No. 4.

LEATHER CRAFTWORK

Lamp Shades

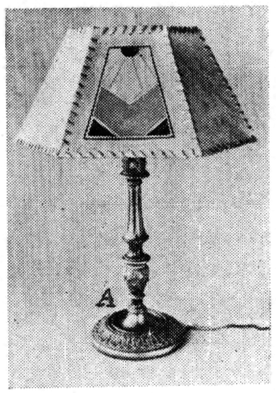
The Lamp Shade A in the illustration is made of calfskin vellum or parchment, decorated with Higgins Inks and edge laced with leather thongs.

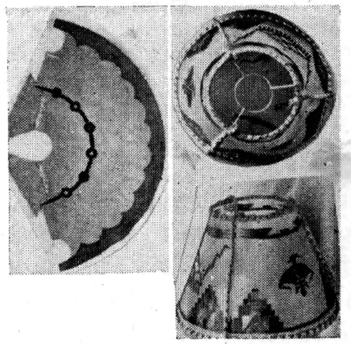
The goat skin tepee is pinned together with wooden pegs after the fashion of the Indian tepee and decorated with typical Indian designs. The larger shade of clarified rawhide is laced with wide buckskin thongs. The decorations on these shades are done with oil paints.

Illumination Characteristics of Rawhide and Parchment

Parchment is translucent but not transparent, and is especially suited for use where general illumination by a diffused light is desired. Parchment is an excellent reflector of light and will yield a local illumination, directly below the shade, of high intensity and pleasing quality. It may be decorated by thin washes of oil paint, colored inks and leather dye.

The clarified rawhide is transparent and more highly translucent than the parchment. The surface may be tinted with washes of dye or oil paints. Higgins Inks are excellent for putting designs on the uncolored surface. It should be applied on the under surface, and the colors are then softened as the light is transmitted through the tinted rawhide. White Ink may be used on areas for back ground or to diffuse the light in sections, leaving the rest translucent.





LEATHER THONG HANDICRAFT

Leather Thong Handicraft is a highly developed Art Craft that found extensive use among ranchmen, cowboys and others on the ranches in the Southwest at the time when cattle raising was at its height. The Plaited Leather Bridles, Bridle Reins, Lariats, Quirts, Hatbands, Whips, Watch-guards made from Leather Thongs were commonplace. Many of the Cowboy's trappings were the product of saddle makers. Others were made by skilled artisans who wrought in native materials (buckskin and rawhide) working without hardware (snaps, buckles, rings, etc.) who devised ingenious fixed and adjustable fastenings for attaching bridle and bridle reins to the bit. The knowledge and skill in the art of Thong Plaiting, which is of Spanish origin, has been transferred from father to son in each generation since the first horses were brought from Spain to American soil.

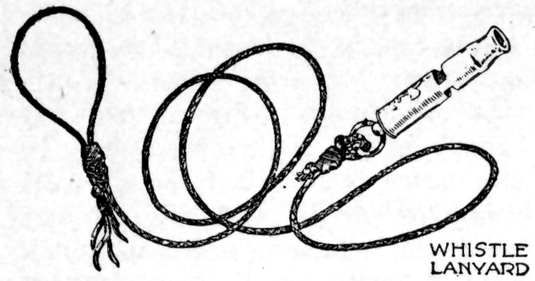
In the Leather Cuffs, Chaps, Pistol Holsters, Rifle Scabbards, and Saddles of these cattlemen were found numerous applications of the Laced Leather Thong Craftwork.

The Indian's bow cord in his fire by friction outfit, the lashings for his tepee, and the trappings for his pony were leather thongs. All tribes of American Indians in their primitive state made use of sinew and rawhide for sewing two pieces of leather together. The sinew-sewed moccasin with the heavy rawhide sole attached to the buckskin upper, and the laced up corners of pouches and bags of rawhide or parfleche with leather thongs, the tom-tom made by stretching two pieces of rawhide over the ends of a hollow log and securing a tension by means of a rawhide thong lacing, are among the examples of primitive Laced Thong Craftwork.

Numerous other applications of Rawhide Thong Handicraft are to be found in the Southwest. Pole corrals and fences have been constructed with rawhide thong lashings in the absence of wire and staples. The Padres, who built the California Missions, made use of rawhide thongs to secure the roof supporting timbers in many of their buildings. In several missions some of the original timber and rawhide lashings are still intact and giving service today. Among the simple furnishings of the early missions and the adjoining ranches, constructed out of rustic materials, are to be found comfortable benches, stools, straight chairs and rockers with the seats and backs made of laced rawhide thongs.

It remained for the hardy Mormon immigrants to furnish the classic illustration of leather thongs used in building construction, where dowel pins and rawhide thong lashings are used to assemble the trussed timbers supporting the arched roof of the widely famed Tabernacle. Finally the traditional emblem of hospitality extended by the pioneer and frontiersman to strangers passing by is the leather latch string dangling on the outside of his cabin door.

The use which the American Indian, the Pioneer Scout, the Frontiersman and others have made of Leather Thongs will serve to guide us in presenting Leather Thong Handicraft as a present day organization activity.



The Art of Plaiting Leather confronts the novice with conditions which must be met fairly and squarely for attainment of the desired results.

It teaches that back of the pictorial instruction in sequential operation, introduced to focus attention on the essential pattern and design detail, certain fundamental principles are to be discovered.

One discovery leads on to another and an inquisitive mental alertness is developed as the search for other principles progresses. The work requires:

1. Concentration and keeping the mind on the work while looking ahead and learning step by step.

2. Observation, then coordination of the eye and hand, force a standardization of manual operation which develops equal skill in left and right hand.

3. Critical inspection of the work done as the plaiting progresses, teaches by the principle of trial and error, the causes of good and inferior work and establishes a standard practice for the control of the quality of the plaiting produced.

4. Systematic, orderly, painstaking effort is required to produce results. An inspection of work which does not have the right appearance will indicate the changes in method of work to produce the desired results.

Thong Cutting Methods

Thongs may be cut by hand from discs of leather with a keen edged, thin bladed knife. The sketches indicate how the width of thong is controlled by the position of the thumb of the hand holding the knife. Fig. 1 shows a method in which the disc, placed at the edge of the cutting block, rotates from right to left as the thong is pulled with the left hand toward the right. The right hand is braced against the edge of the table with the thumb in the position of a gauge, as indicated.

In Fig. 2, the gauge is established between the points of the knife fixed in the wood cutting block and the side of the thumb which is pressed against both thong and block to control thong width as it is pulled from right to left.

A similar method is used by whip makers to produce tapered thongs from strips of leather of the desired lengths. The hand position is the same as in Fig. 2, and the strip of leather moves across the table under the fingers as the thong is pulled toward the left. The tapering is controlled by varying the pressure of the thumb against the thong, and the expert calls this action the "squeeze." To protect the thumb from a friction burn, the tip of an old glove may be worn. A piece of gummed tape will also serve. See page 61.

Fig. 3 shows a Pioneer method in which the knife is held with the left hand, and the disc rotated against a notched piece of wood screwed to the block. The thong is pulled with the right hand in the direction indicated. This method is more certain to yield a satisfactory thong for a beginner than either of the hand methods described.

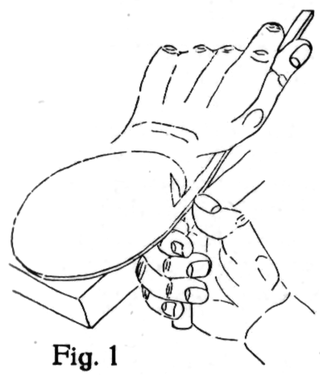


Fig. 1

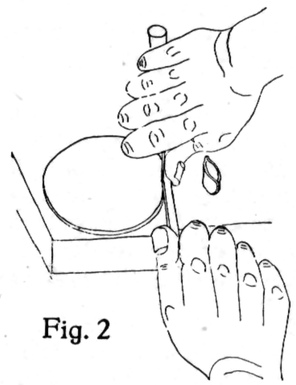


Fig. 2

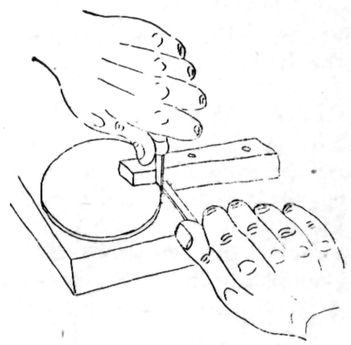
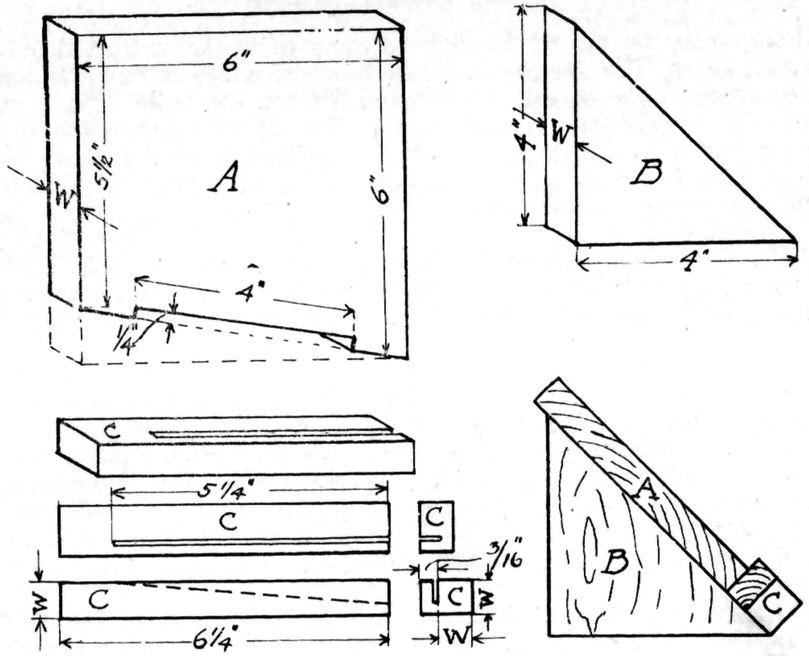


Fig. 3

Thong Cutter Specifications

The specifications for the cutter developed and used by the writer are given herewith for the benefit of those who wish to make their own. The dimension of each part is shown in the sketch marked A-B-C. Assemble the cutter by fastening part C to part A with nails or screws. Mount the A-C portion of the cutter on the supports B placing them about one-half inch from the ends of part A. This cutter is protected by patent and must not be manufactured for sale. Permission, however, is granted to individuals who may care to construct and use this cutter.



Thong Cutter Methods

The Thong Cutter method is indicated by the sketches, Figs. 1 to 7.

1. Place the disc on the cutter with the smooth or grain surface against the board and press the leader thong into the saw cut, Fig. 1.

2. With the knife placed diagonally across the cut in the position, Fig. 2, hold the cutting edge firmly in contact with the block on both sides of the saw cut at points A-B. The thumb and forefinger press on the edge of the block at C-D, and keep the cutter from moving as the thong is cut. Note that the knife is held across the cut at the point, Fig. 4, where it is exactly the depth of the width of the leader thong. Any variation in this position will increase or decrease the thong width and distort the circular disc so that it will not cut evenly.

3. Pull the leader thong gently with the left hand. As the disc revolves and decreases in diameter a thong of increasing length is produced. With care only a fragment of the original circle will remain.

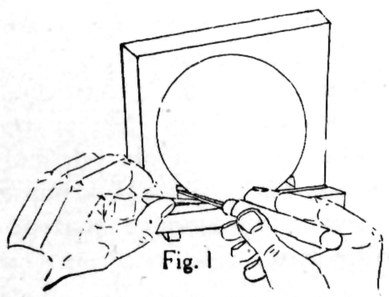


Fig. 1

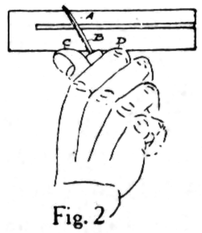


Fig. 2

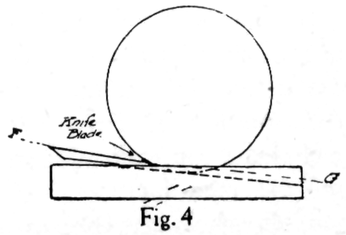


Fig. 4

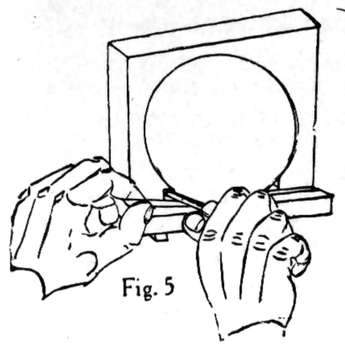


Fig. 5

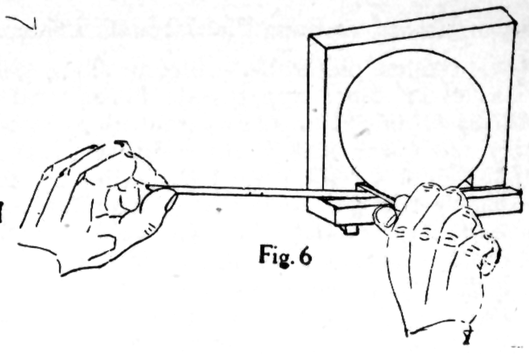
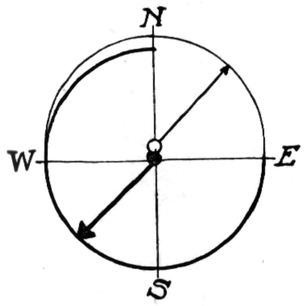


Fig. 6



Construction of a Disc

In each of the methods above described, thongs are cut from leather discs which must be properly constructed to insure success. The sketch indicates a method of laying out a disc with a compass. The leader thong is started by cutting from point W to N along the heavy line. The width at N should be that of the desired thong length.

The following table gives the approximate length of thongs of four widths which can be cut from discs of the diameters indicated.

Diam. of Disc	Width of Thong 1-16 in.	3-32 in.	1-8 in.	3-16 in.
4 in.	16.7 ft.	11.2 ft.	8.3 ft.	5.5 ft.
3 in.	9.4 ft.	6.3 ft.	4.7 ft.	3.2 ft.
2 in.	6.0 ft.	4.0 ft.	3.0 ft.	2.0 ft.

Thong Cutting Knife

The knife best suited for thong cutting should have a thin blade with an edge honed and stropped to a razor like sharpness.

A fixed or extension blade, approximately 1/32" thick and 5/16" wide can be ground to the desired shape, on a fine grit, abrasive stone or wheel.

Shaping the Blade. The proper shape of blade is a wedge, the top of which is tapered to the cutting edge in a distance of about 3/16".

Honing the Edge. A fine grain oil stone is excellent for sharpening the knife edge, also for restoring it as it becomes rounded or turned over by use in cutting tough leather fibers.

Stropping the Edge. The drawing of the knife blade across a piece of smooth leather to straighten turned edges is essential from time to time. It is an excellent practice to "charge" the surface of the leather, by rubbing in to it Jewelers Rouge, a polishing abrasive. This in reality makes the strap a "Buff" (which refers to the process of polishing metal). A mirror-like polish is given to the wedge surfaces of the knife blade. This polished surface reduces the drag which leather exerts on knife blades. This drag increases with the thickness of leather.

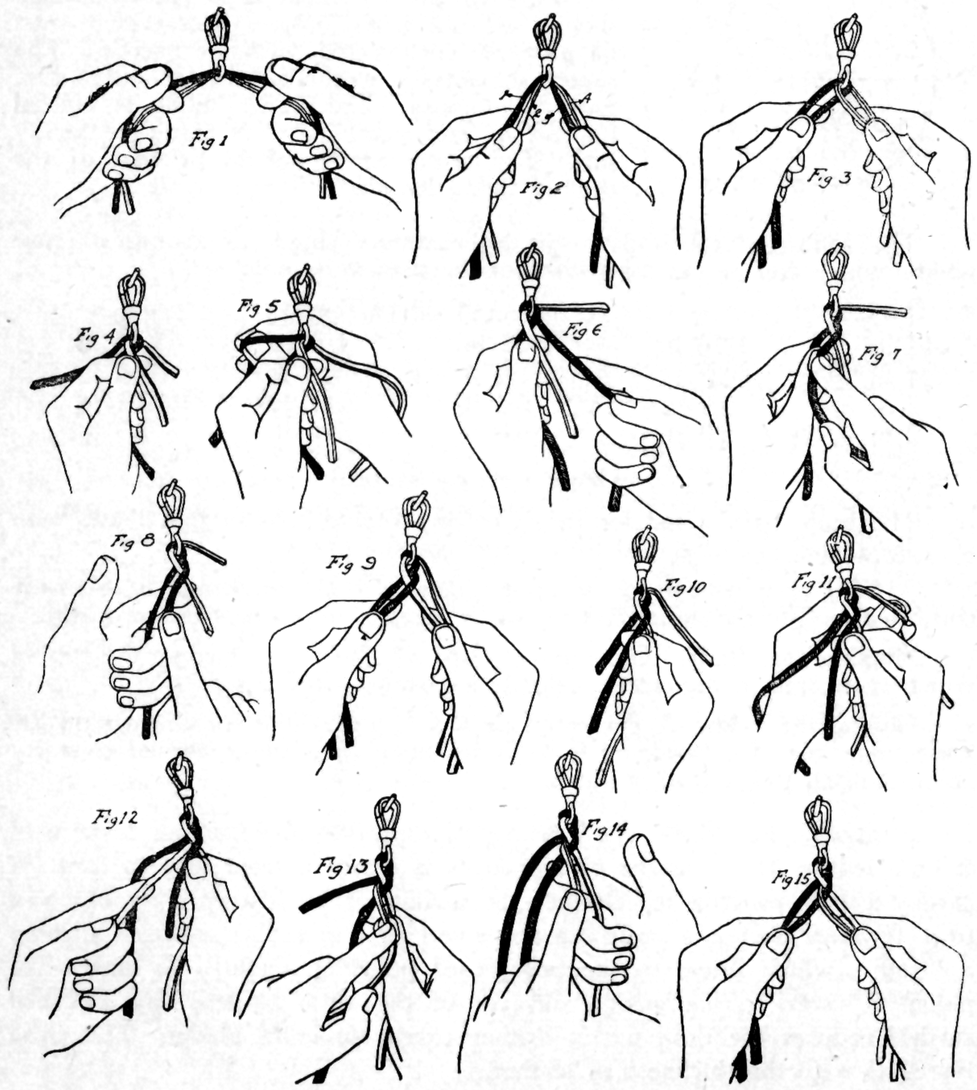
Four Plait Round

Starting a Strand of Four Plait Round, Diamond Pattern.

Two thongs preferably of contrasting colors are passed thru the ring of a swivel or other appropriate fitting, and pulled to their middle point. One thong is placed on top of the other, smooth sides uppermost. See Fig. 1. Carry the uppermost thong to the left and position the thongs as shown in Fig.2. Count off from the left, giving the thongs numbers 1-2-3-4.

Carry thong 2 over thong 3 and separate the thongs into pairs 1-3 and 2-4. Notice that the color arrangement established brings a color separation as shown in Fig. 3. This color arrangement with both black thongs on the left and both white thongs on the right, will be maintained as a guide and basis of reference in building up the plaiting procedure. This gives the Diamond design. The color arrangement shown in Fig. 6, page 108, will yield the Spiral design.

I. Grasp the crossed thongs Fig. 3, with the left hand as shown in Fig. 4.



II. Reach thru between the white thongs and grasp the black thong as shown in Fig. 5.

III. Bring the black thong around behind the crossed pair up between the white thongs, see Fig 6, and carry it over the lower white thong as shown in Fig. 7.

IV. Remove the left thumb, Fig. 8, from its position shown in Fig. 7 and grasp both black thongs as shown in Fig. 9.

The procedure from here on is identical, but the manipulation changes from the left to the right hand, as indicated in Sketches 10 to 15, page 106.

This completes the cycle for both hands.

Notice that the tension or pull must be kept on the thongs as the plaiting progresses. This is accomplished by grasping one thong with three fingers of each hand as shown in Fig. 5 and Fig. 6 especially. Also in Fig. 11 and 12 for the left hand. This releases the thumb and forefinger of each hand to manipulate the thongs and for holding them in place. After a little practice there will be no difficulty in keeping the proper amount of tension on the thongs to prevent them from loosening while changing from one hand to the other. Notice Fig. 4 that the lower black thong is grasped firmly with three fingers of the left hand and the white thong crossing it, is held securely between the thumb and forefinger. The same conditions exist in Fig. 11 which shows the right hand.

Ending the Four Plait Round

Formation of Crown and Terminal Turkshead

Refer to Fig. 15, page 106, in the series of sketches illustrating the Four Plait Round, also Fig. 7A, below, and bring the highest thong (a) around back of the strand and place it against thong b, flesh sides together. Remove thong c and place it against thong d, flesh sides together. This separates the thongs into two pairs, each containing one right hand and one left hand spiral thong as indicated in Fig. 7, Sketch A. From this thong arrangement form a crown as indicated by Sketches C to H.

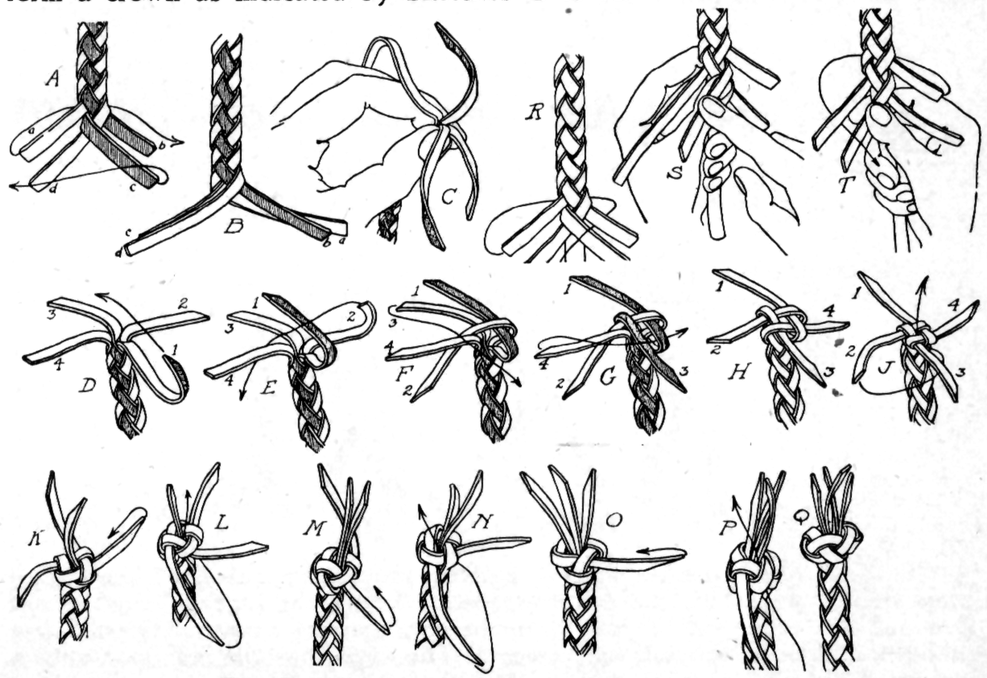


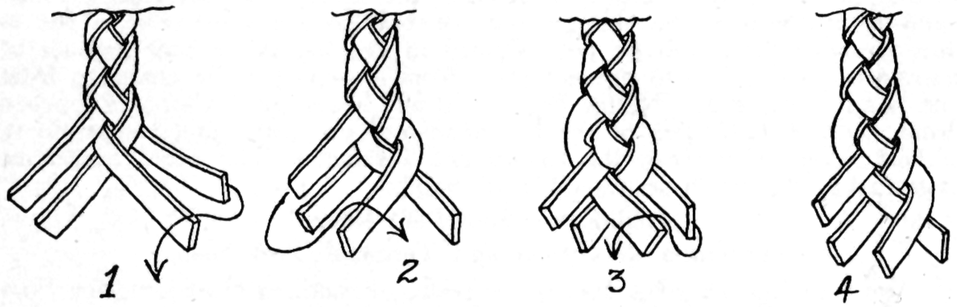
Fig. 7

Four Plait Flat

Four thongs partially plaited after the method described in four plait round, may be plaited or woven flat where such sections are required, as in several projects which will be given later. Four plait flat may also be used in making belts, hat bands and other articles. In making the change from round to flat, the four thongs are pulled taut and flat in the position shown in Fig. 1. The operation consists of weaving each thong over one and under one as shown in Figures 1 to 4.

Continue this weaving process for the desired length. The resumption of the round plait may be continued in the diamond pattern as Sketch A, Fig. 7, page 107, or changed to spiral as described under Fig. 6 below.

Sketches R, S and T of Fig. 7 show the continuation of the four plait round which is started as above described.



Rolling the Four Plait Round

The plaited strand should be rolled under a board or foot to smooth out any unevenness and to equalize the tension on the thongs. When rolled sufficiently the plaited strand should equal the width of the thongs from which it is made.

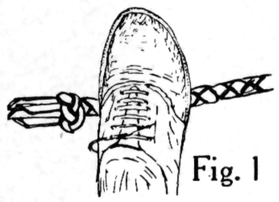


Fig. 1

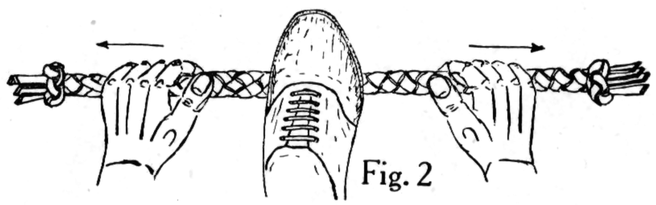


Fig. 2

Spiral Design:

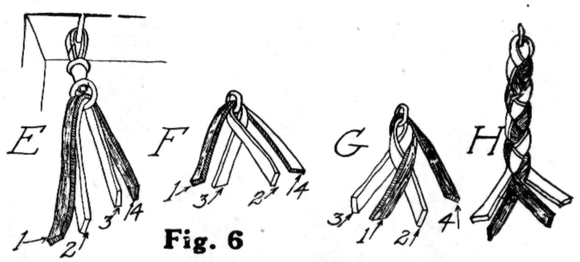


Fig. 6

In four plait round diamond pattern previously described, note that after step 3, page 106, the color separation brings the black thongs on one side and the white on the other. In the arrangement above illustrated one thong is crossed over itself as 2 over 3. This separates the colors as shown in Sketch G. This arrangement results in a spiral pattern.

Crown on Crown Terminals—Square

Start with a terminal turkshead at the end of a Plaited Strand and form a Crown as indicated by the sketches showing the formation of Crown on page 107. Proceed to form one crown upon another. Sketches in Figs. 1 to 11 show the process step by step. Fig. 12 shows the appearance of the terminal before the ends are tucked back under the next lower crown. Fig. 13 shows the appearance of the Four Thong Square terminal after the ends have been tucked under and trimmed off.

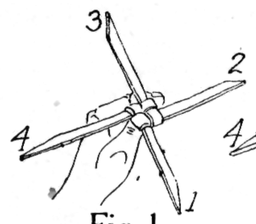


Fig. 1

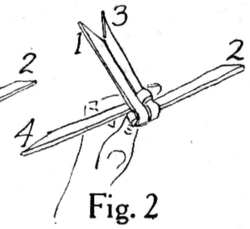


Fig. 2

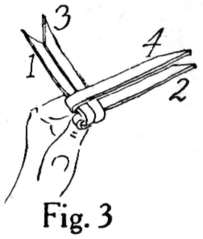


Fig. 3

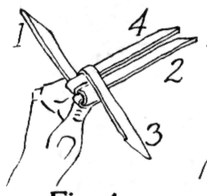


Fig. 4

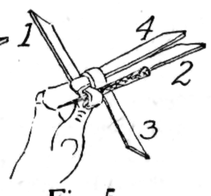


Fig. 5

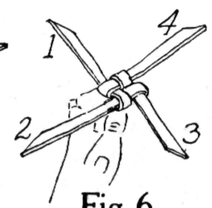


Fig. 6

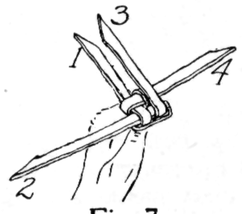


Fig. 7

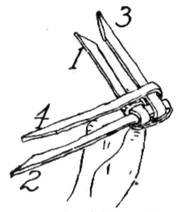


Fig. 8

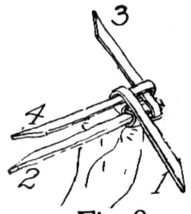


Fig. 9

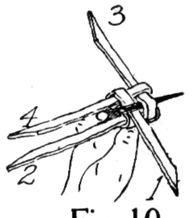


Fig. 10

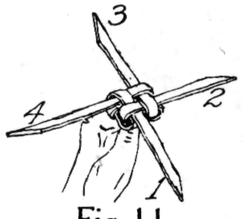


Fig. 11

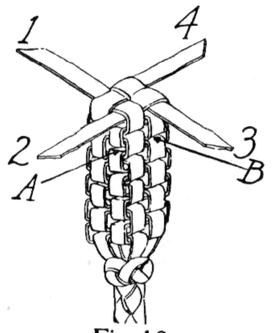


Fig. 12


Fig. 13

Spiral

The start is the same as in the square. The second and each succeeding crown however is rotated 45 degrees. Sketches in Figures 1 to 6, page 110, show the procedure step by step. Fig. 7 shows the appearance of the Four Thong Spiral Terminal before the ends are tucked back under the next lower crown and trimmed off.

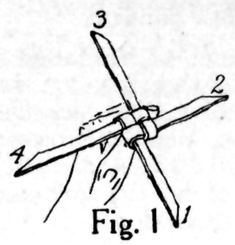


Fig. 1

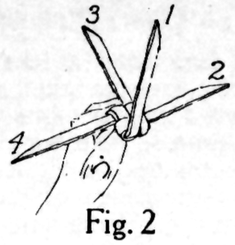


Fig. 2

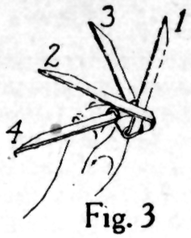


Fig. 3

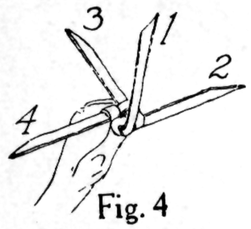


Fig. 4

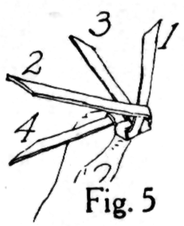


Fig. 5

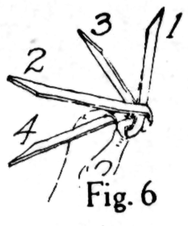


Fig. 6

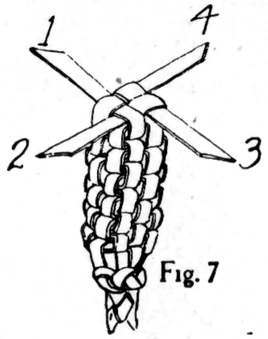


Fig. 7

Spiral Reverse

Start in the manner described for the Square and Spiral Terminals build crown on crown rotating each 45 degrees, keeping each thong smooth side uppermost. Sketches in Figs. 1 to 9 show the procedure step by step. Figure 10 shows the appearance of the Spiral Reverse Terminal before tucking the thong ends under the next lower crown and trimming off.

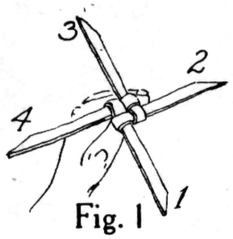


Fig. 1

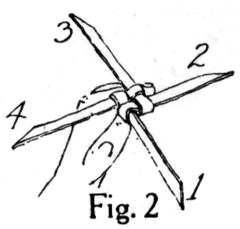


Fig. 2

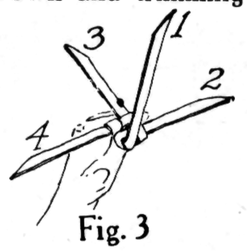


Fig. 3

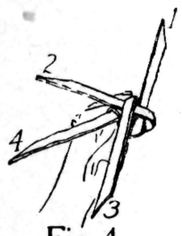


Fig. 4

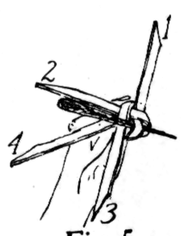


Fig. 5

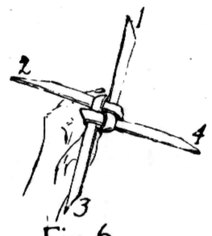


Fig. 6

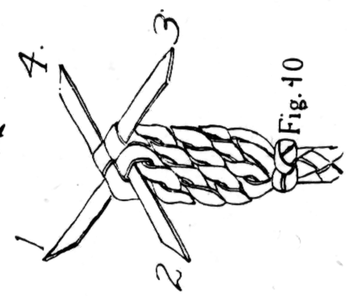


Fig. 10

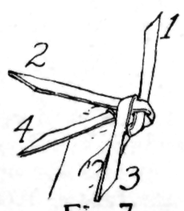


Fig. 7

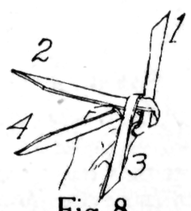


Fig. 8

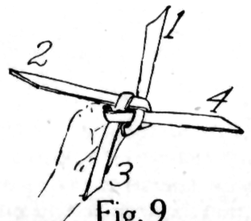


Fig. 9

The Sliding Knot

The Sliding Knot is an essential element in leather thong work. Its purpose is to unite round plaits and hold them in position, also to permit making adjustments for length. Figs. 1 to 13 show a sliding knot as tied to unite two strands of four plait round. This knot is later described as a five strand, two bight type, and finds application in Hat Bands, Whistle Lanyards, Watch Fobs and numerous other plaited articles requiring fixed or adjustable fastenings.

The strands to be joined are placed side by side and the knot formed with a single thong as indicated in the sketches, Figs. 1 to 13. (The term bight, hereafter used, is of nautical derivation and refers to the contact points of one or more thongs held in position by friction of the surfaces.)

1. With the two strands and the end of the thong held in the left hand, Fig. 1, carry the free end of the thong over and around the strands to form bight No. 1, Fig. 2. Repeat this step to form bight No. 2 and 3 as indicated.

2. In Fig. 4 a marlin spike is inserted to permit the free end of the thong to be passed underneath the bound thong as indicated in Fig. 5, and around the strands, Fig. 6.

3. Insert the marlin spike under the bound thong between bights 1 and 2 and carry the free end through and around as shown in Figs. 8 and 9. Figs. 10 and 11 show the next step.

4. The Knot is completed by paralleling the single thong structure, following through the steps of the preceding operation, and ending as in Fig. 12 with the slack removed to make the knot sufficiently tight and the end concealed as in Fig. 13.

Fig. 1

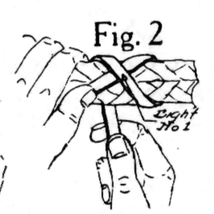


Fig. 2

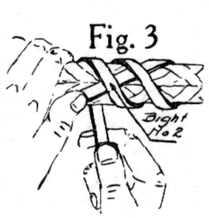


Fig. 3

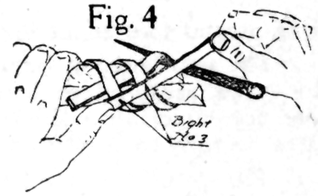


Fig. 4

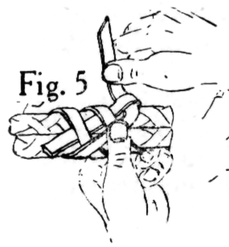


Fig. 5

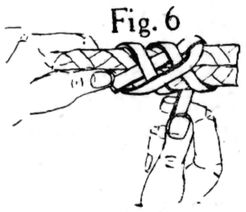


Fig. 6

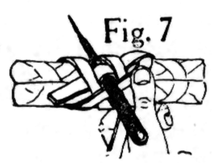


Fig. 7

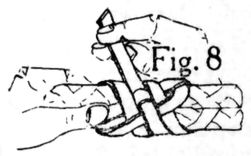


Fig. 8

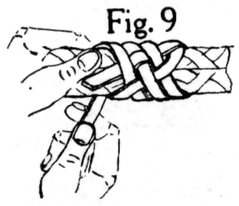


Fig. 9

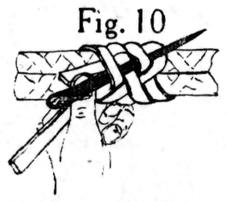


Fig. 10


Fig. 11


Fig. 12

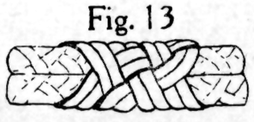


Fig. 13

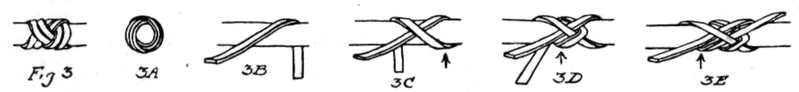
Ornamental Knots

The following knots constructed with a single thong are the typical ones used on plaited articles such as Quirts, Bridles and Reins. The function of a knot may be purely one of ornamentation or for the purpose of concealing a splice underneath, also for the addition of weight and to give stiffness to a plaited strand, or in the making of fixed and movable parts of adjustable fastenings.

Two Bight Knots

Three strand two bight knot.

The construction details shown in Fig. 3, 3 (A-B-C-D-E) indicate the steps required in forming a three strand two bight knot. This knot is used primarily for ornamentation of a plaited strand, also in making an adjustable fastening. See Fig. 25.



Five strand two bight knot.

The construction details shown in Fig. 4, 4 (A-B-C-D-E) indicate the steps required in forming a five strand two bight knot. This knot is used to make the sliding part of an adjustable fastening. See Fig. 5-A, page 113, for another way to tie this knot.

Nine strand two bight knot.

The construction details shown in Fig. 5 (A-B-C-D-E-F-G-H) indicate the steps required to form the nine strand two bight knot. This knot is used for covering a splice, for ornamentation, and to add stiffness and give extra weight to a plaited strand.

The principles used in making this knot may be applied to the formation of Quirt handles by wrapping the desired length with spirals as shown in Sketch A, and then wrapping back with the same number of spirals less one as shown in Sketch B. Continue as shown by Sketches (C-D-E-F).

It remains to fill out the knot by paralleling the original thong structure throughout all the steps illustrated. Upon completion of the paralleling operation remove all slack and cut the ends off up close to the double crossed strand from which they emerge. The finished appearance after rolling is as shown in Sketch H.

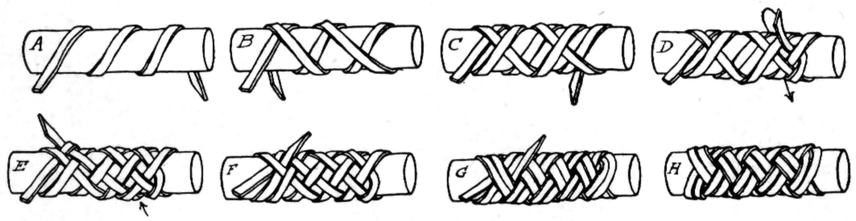


Fig. 5

This knot may be made any desired length by increasing the number of spiral wrapping (Sketch A) and when finished has the appearance of a strand of four plait round.

Two Bight Knots

Form the Single thong structure as shown in Figs. 1 to 10. Then parallel the single thong, see Figs. 11, 12, and 13, page 111.

Fig. 5A shows a sliding knot tied to a single core as a cane or whip handle. Note that sketches G and H show reverse appearance of step indicated in F.

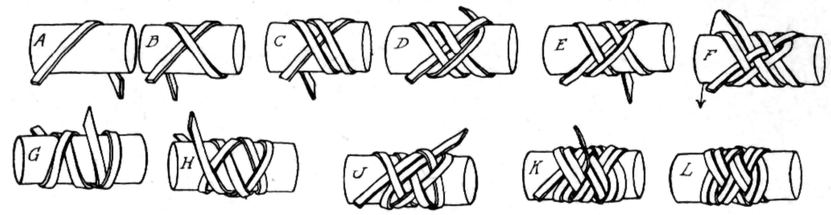


Fig. 5A

THREE BIGHT KNOTS

Unit Length Knot

The construction of the three bight knot is illustrated in Sketches A to G. The single strand structure is shown in Sketch H. This knot may be

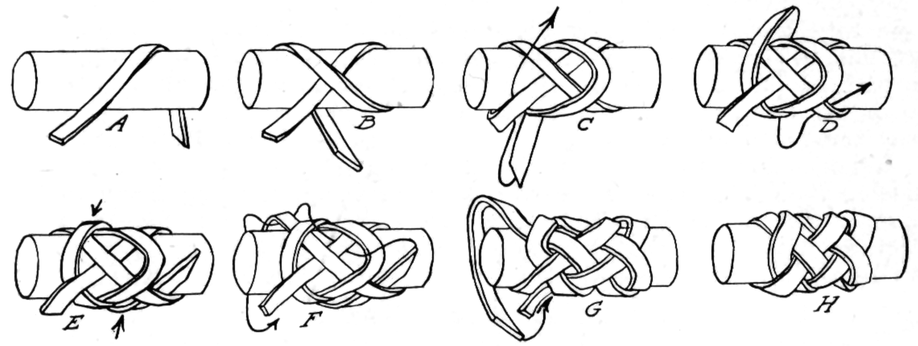
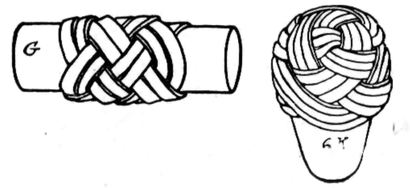


Fig. 6

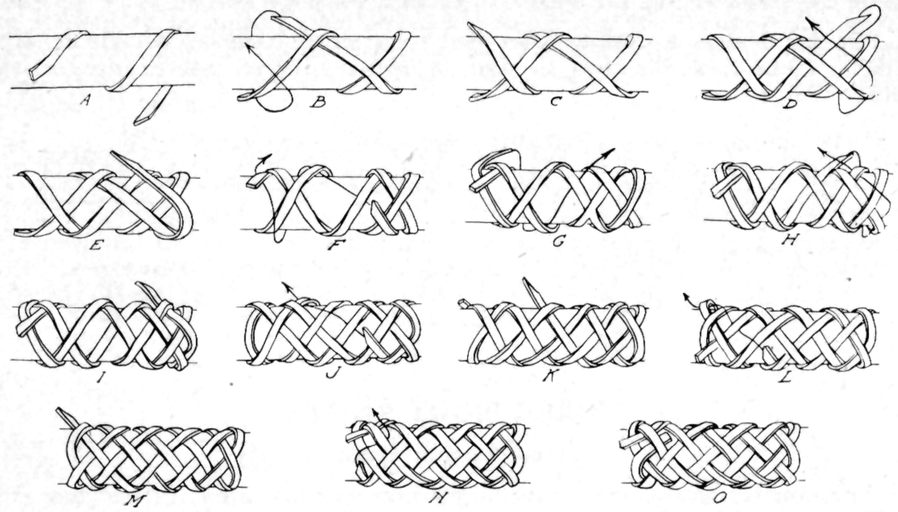


enlarged to cover more surface by paralleling the single thong structure, shown in Sketch H. The appearance of the knot after the paralleling process is shown in Sketch I. Notice each strand is double the width of the single strand structure. This process may be continued by paralleling the double strand structure as shown in Sketch 6-K which makes each strand three times the width of the single strand structure.

Double Length Knot

The three bight knot detailed in Sketches A to G we will call the unit length knot for purposes of comparison. The three bight knot detailed in Sketches A to L we will call the double length knot. Refer to Sketches A and B, Figure 6, page 114, and note that **unit length three bight knot** is

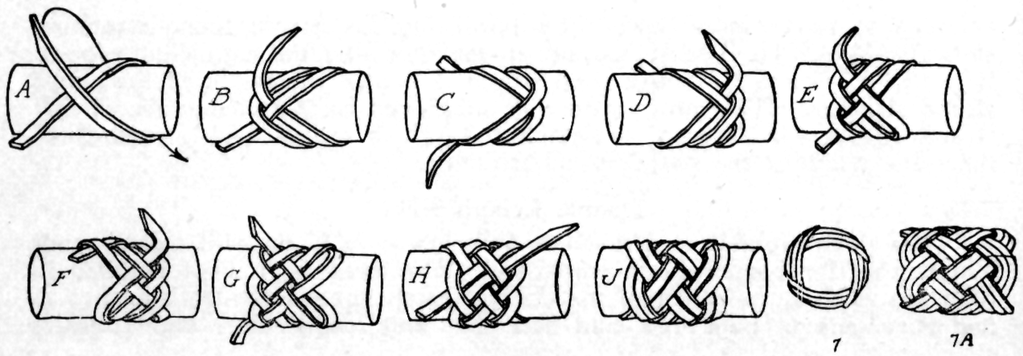
started with one turn of thong around the core. Refer to Sketches A and B below, and note that the **double length** three bight knot is started with two turns of thong around the core.



The construction of the three bight double length knot is illustrated in Sketches A to O. The mandrel or core on which the knot is formed —see Sketches A to E—has not been moved. However in Sketch F the core has been turned forward almost one half turn to show more clearly the path of the thong on the under side of the core. Sketches E to I are shown for the new position of the core. Again rotate the core forward about one-half turn and bring it into the position shown in Sketches J and K. Again rotate the core forward and bring it into the position shown in Sketches L and M. Rotate the core forward again, bringing it into position shown in Sketch N. The single strand structure is shown in Sketch O. This structure may be paralleled as described for the unit length knot and also may be drawn over the end of a core as shown in Sketch 6K, Fig. 6.

FOUR BIGHT KNOT

The four bight knot is illustrated below. Sketches A to J show construction details. This knot is sometimes made from a single wide thong. When a narrow thong is used it is made double or triple strand as illustrated. Sketch H shows the completed structure and the start of the paralleling operation. In case the double strand knot does not close up all open spaces, parallel the double strand structure and obtain a triple strand knot. This knot is used in Quirt making both as an ornament and also to conceal a splice at the junction of the handle with the tapered section of a quirt.



Neckerchief Turk's Head

The sketches show the construction of a five bight knot used for a Neckerchief Turkshead Slide. A continuous plait of three braid is formed with a single thong as detailed in Figs. 1 to 12. A four plait strand with terminal Turkshead knots is also used.

1. With the strand held in the left hand, Fig. 1, form bights 1 and 2, then insert the free end under the fixed thong to form bight 3.

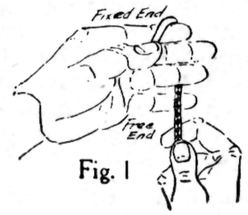


Fig. 1

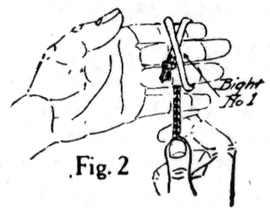


Fig. 2


Fig. 12

2. Reversing the hand, Fig. 4, carry the free end under and over the thongs crossed to form the bights in Figs. 5 and 6.

3. Insert the strand under the right hand loop, held with the marlin spike, and pull taut.

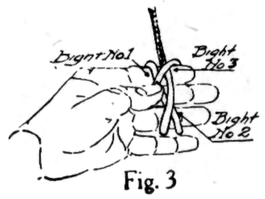


Fig. 3

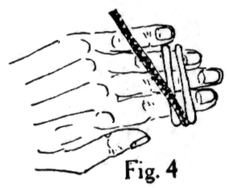


Fig. 4

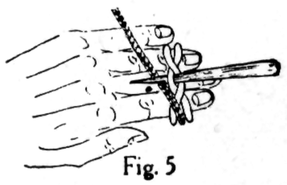


Fig. 5

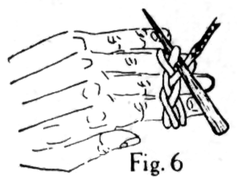


Fig. 6

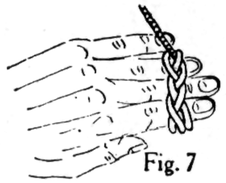


Fig. 7

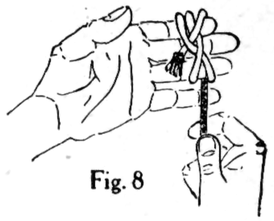


Fig. 8

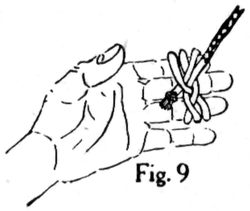


Fig. 9

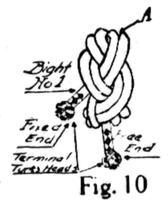


Fig. 10

Fig. 11


Fig. 13

4. With the hand in position, Fig. 8, carry the strand over the lower left hand loop and up under the strand to the right of bight 2, Fig. 9. This completes the formation of the single Turkshead structure.

5. Remove the single strand knot from the hand and form a parallel structure by weaving the free end of the strand under and over the bights as above until it emerges at bight No. 1 as in Fig. 11. This completes the formation of the double Turkshead Knot.

6. Conceal the knot ends of the four plait strand under bight No. 1. It is assumed that the necessary length of strand has been determined and the terminal knots tied before the slide is started. Insert the spike under the

beginning of the slide at point A, Fig. 10 and pull it up into a loop to draw the terminal knot firmly against the under side of bight No. 1, Fig. 11 at point B. Insert the knot at the end of the strand or the free end, at point C and pull the loop to draw it against the under side of the bight in the same way as with the first knot.

7. Carry the slack formed in loops A and D forward under each bight until it is entirely distributed.

Flat Plaits

The illustrations Figs. 20 to 23 show the appearance of flat plaited strands made from seven, nine, eleven and thirteen thongs. Figures 20 and 20A show two design patterns which are made with seven thongs, one a simple over one and under one weave, the other a herring bone pattern produced by carrying the thongs over two and under two.

In Fig. 21, nine thongs are woven in to the design shown by carrying each thong under two over one and under one and over two.

In Fig. 22, eleven thongs are woven into the design shown by carrying each thong under two, over two, under two and over two.

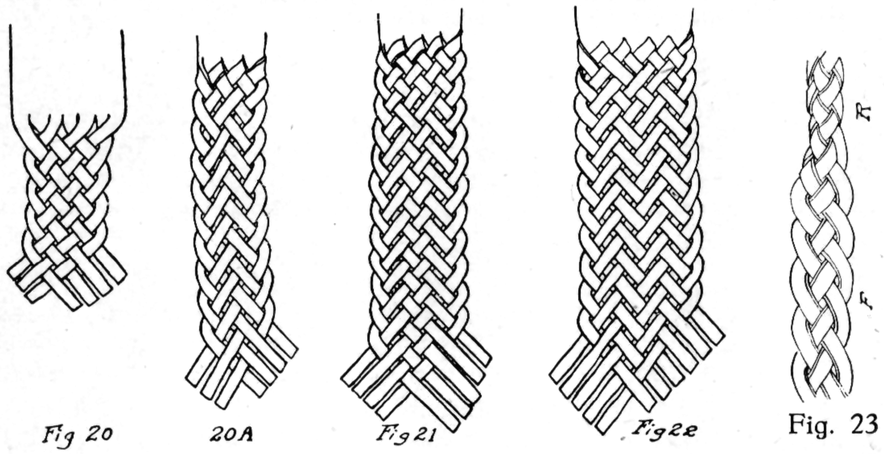
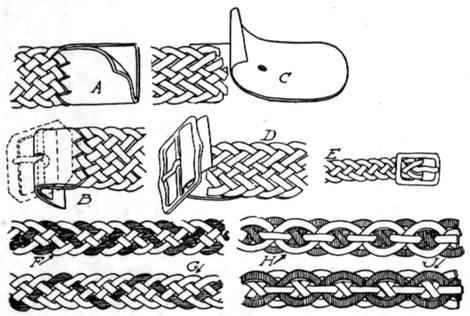


Fig 20 20A Fig 21 Fig 22 Fig. 23



Sketches A to J show belts made from wide strips that have been split into the desired number of thongs and started by folding the wide end over itself as shown in sketch B, and the end stitched or cemented down. The ending of the plaited strand and a method of attaching the tongue is shown in sketch C. Two pieces of the same leather are cemented together flesh sides inward. The ends of the plaited strand are held firmly between the end pieces, see sketch C. The end may be machine or hand stitched across instead of cementing if desired.

Thongs of different colors may be used and the ends secured at the buckle end by the method shown in sketch C.

The length and width of flat plaited strands is approximately 2/3rds of the length and width of the thongs from which it is made.

Six Plait Round

The six plait round is illustrated in Fig. 1. The construction detail is shown in Sketches 1 (A-B-C-D-E-F). The six thongs are spaced equally about a core and secured with a short length of twine.

I. Cross thong 1 over thong 6, sketch 1A.

II. Bring thong 4 under thong 5 and over thong 1, sketch 1B.

III. Bring thong 3 under thong 2 and over thongs 6 and 4, sketch 1C.

IV. Bring thong 2 around behind the core under thongs 5 and 1 and over thong 3, sketch 1D.

V. Referring to sketch 1D notice thong 5 is the highest thong on the left, bring it around behind the core under thong 6 and over thongs 4 and 2. See sketch 1E.

VI. Referring to sketch 1E notice thong 6 is the highest thong on the right, bring it around behind the core under two thongs and over one as shown in sketch 1F.

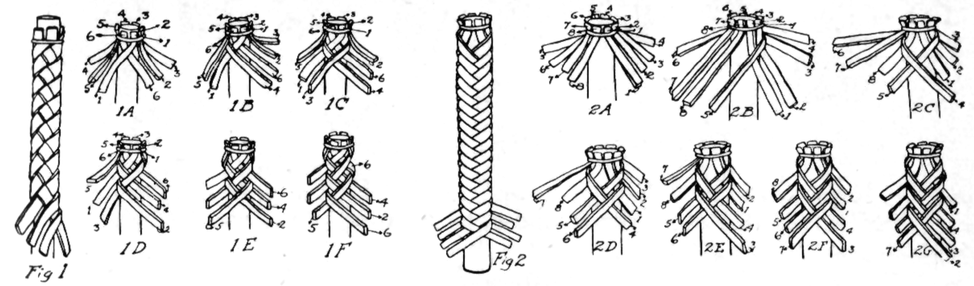


Fig 1 Fig 2

Eight Plait Round

The method of plaiting eight strands is shown in Fig. 3, sketches A to G. For convenience in starting the plait, the strands are separated into two groups of four each and supported as indicated in sketch A.

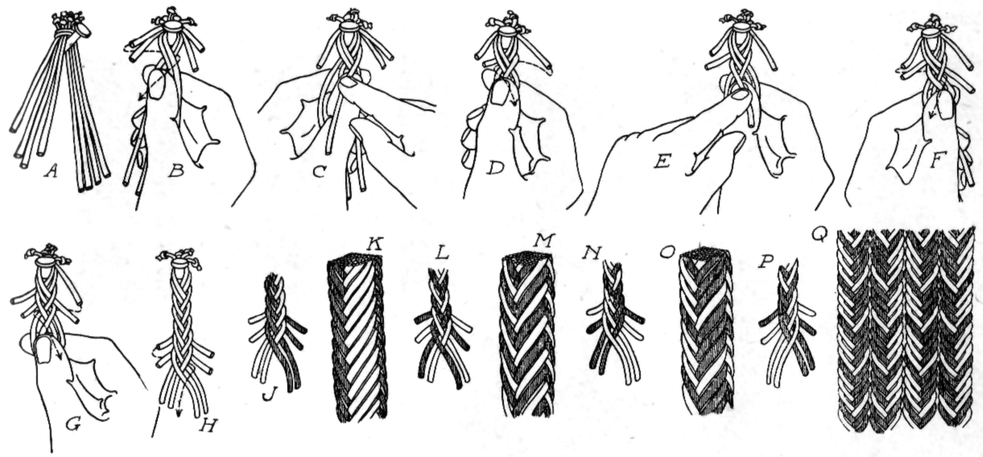


Fig. 1

Cross the two left hand strands over the two right hand ones as shown in sketch B. The highest thong on the left is brought around behind the strand, under the two right hand strands, and over two as indicated in sketch B, and in place in sketch C. Change hands and repeat the operation from right to left, as shown in sketches D and E. The principle then for eight plait is as follows: Bring highest strand around behind the plait, under two

and over two. Change hands and repeat, using the highest strand on the opposite side of the plait.

Eight Plait Designs

In Fig. 3, sketches K, M, O, three patterns are presented which appear in a strand of eight plait when following the strand arrangement shown in sketches J, L, N.

Twelve Plait

The procedure in plaiting twelve strands is similar to that described for eight strands. The start is made by crossing the three left hand strands over the three right hand strands, Fig. 4, sketch A. The principle for twelve

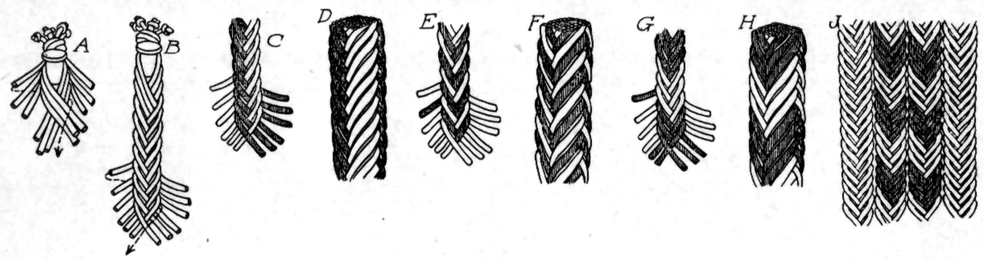


Fig. 4

plait follows: Bring the highest strand around behind the plait, under three and over three. Change hands and repeat, using the highest strand on the opposite side of the plait.

Sixteen Plait

The sixteen plait is produced in a similar manner to the eight and twelve plait. Start the plait by crossing four left hand strands over the four right hand strands, Fig. 5, Sketch A. The principle for plaiting sixteen strands follows: Bring the highest strand around behind the plait under four and over four. Change hands and repeat using the highest strand on the opposite side of the plait.

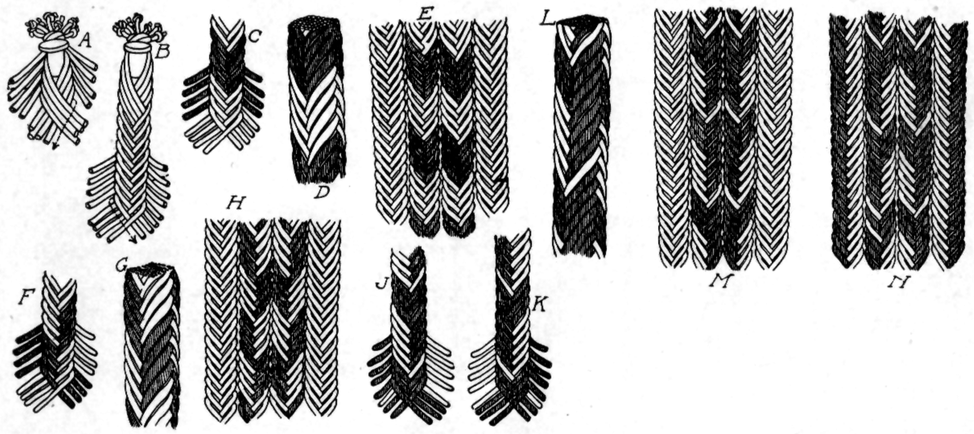


Fig. 5

Sixteen Plait Designs

In Fig. 5, sketches D, G, L, three patterns are presented which appear in a strand of sixteen plait when following the arrangement shown in sketches C, F, J. Sketch K shows the same pattern as that appearing in sketch J, only reversed.

SIX BIGHT KNOTS

Unit Length Knot

The construction of the six bight knot is shown in Sketches A to L, Figure 8. This knot is tied over a mandrel or core which should be rotated as the knot is developed. The construction indicated by Sketches A and B

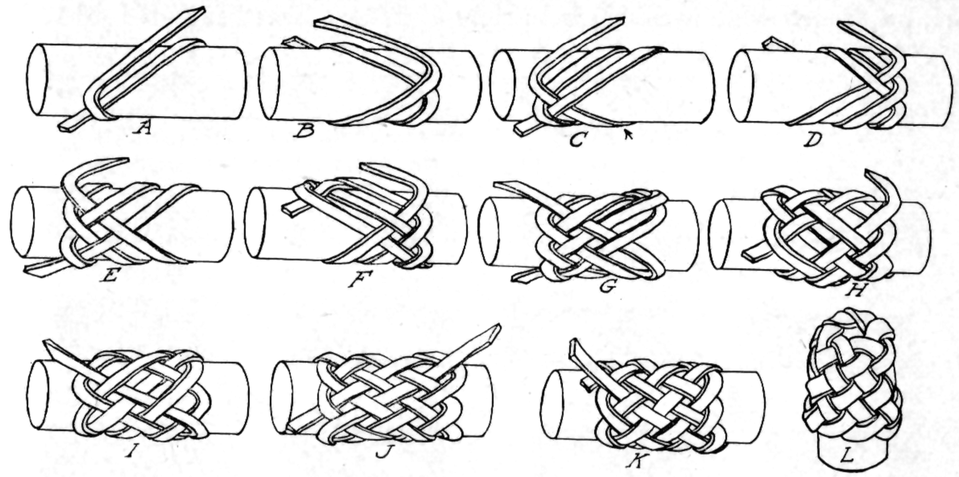


Figure 8.

is done with the core in one position. Rotate the core forward almost one-half turn to bring the thongs into the position shown in Sketch C. Again rotate the core and complete the construction indicated by Sketch D. Continue to rotate the core and complete the construction indicated at each position by Sketches E to K. This knot may be shaped to fit over the end of the core as indicated by Sketch L.

Double Length Knot

The construction of the double length six bight knot is shown in Sketches A to Z, Figure 9. Refer to Sketches A and B, Figure 8, also Sketches A-B-C, Figure 9, and note that the construction principle is similar. The double length knot contains two turns of the thong around the core before the construction is started. In Sketch C, Figure 9, the two turns of thong are shown in place and the thong is crossed over the end at the starting point. This structure is the same as indicated in Sketch A, Figure 8.

1. Wrap the thong around the core, paralleling the first part of the structure as indicated in Sketch D. Thus far the knot structure has been formed by wrapping the thong around the core.

2. Cross over the outside loop, see right end of knot, Sketch D, and parallel the thong on the left, back to the starting point. This time weave the construction thong under, over, under, over, in the order named, each of the four thongs crossing the guide thong which is being paralleled. Then carry the thong under itself at the starting point as shown in Sketch E.

Double Length Knot

3. Cross over the outside loop (left end of knot, see Sketch E) and parallel the thong just crossed (using it as a guide) to the right end of the knot. Remember that the free end of the construction thong must be woven under, over, under, over, in the order named—each of the four thongs crossing the guide thong. Note the guide thong is **on the right** while weaving the construction thong from left to right. See Sketches F-J-N-O and **on the left** while weaving from right to left see Sketches G-K-L-M-Q-R.

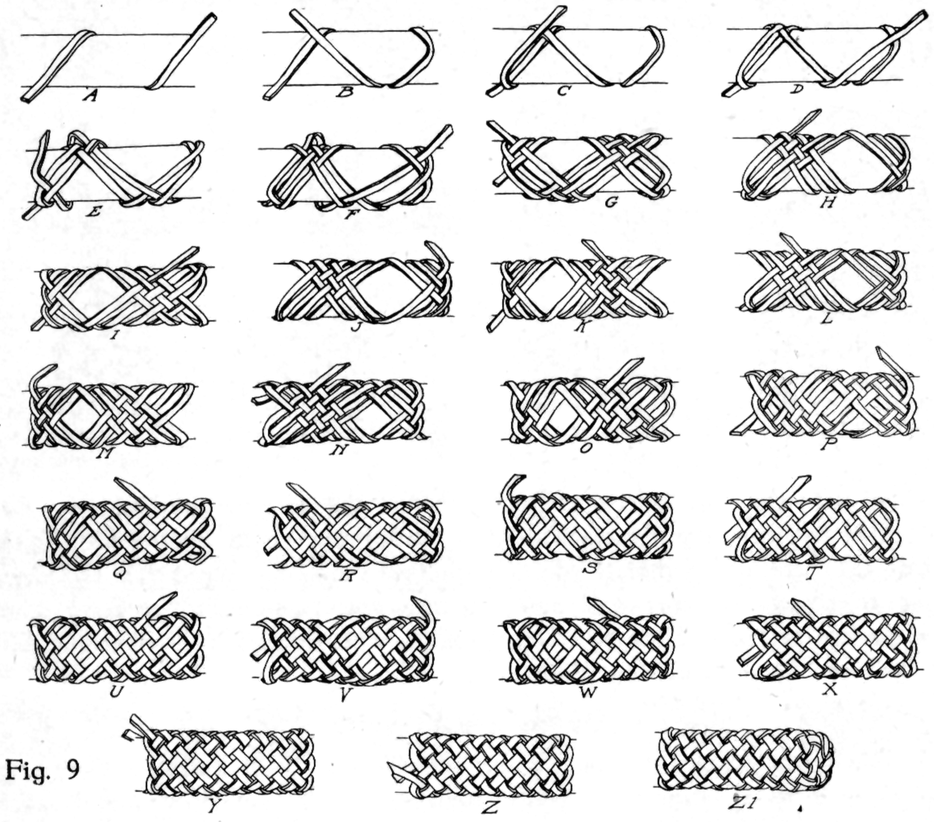


Fig. 9

4. Cross over the outside thong, see Sketch F, and parallel the guide thong—now on the left. Weave the construction thong over, under, over, under, in the order named, the three thongs shown in Sketch G. This group of three thongs are the first encountered after crossing the outside thong shown in Sketch F. Two more groups of thongs, three each, are encountered before the outside loop, on the left is crossed and the procedure repeated.

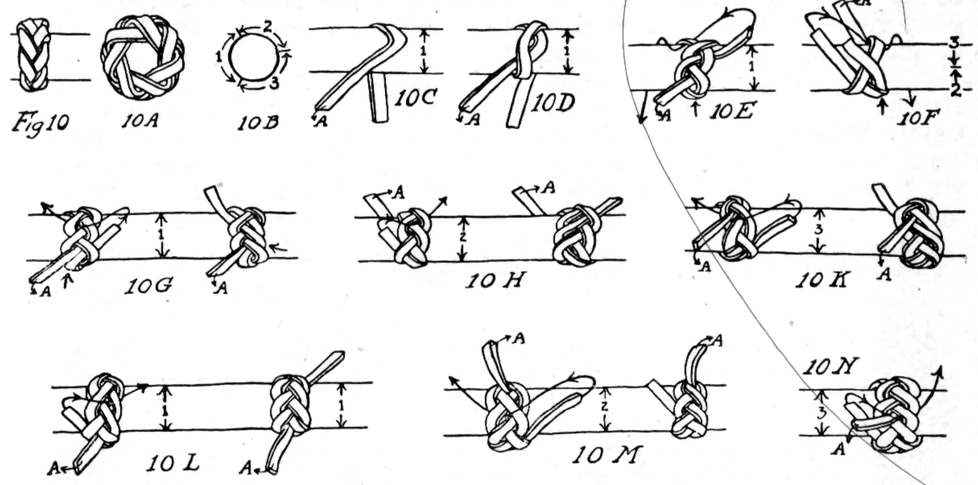
After five complete passages of the construction thong from end to end the knot structure appears as indicated in Sketch S. The unfinished portion of the knot must be filled in by weaving the construction thong over and under each strand, from left to right.

5. Cross over the outside thong, see Sketch V, right end, and weave the thong back to the starting point. Finish the knot by drawing the ends showing at the left hand edge, Sketch Z, back into the woven structure and trim off after they are securely tucked under.

Sketch Z-1 shows this knot drawn over the end of the core.

Seven Bight Five Strand Single Thong Knot

The seven bight knot is illustrated in Figures 10 and 10A. Sketches 10 (C to N) show the construction details. Sketch 10B shows the circumference of the core divided into three equal parts, No. 1-2-3. The core is rotated as the construction of the knot progresses and the portion visible is indicated by the part number that is uppermost in each sketch. Sketches 10 (C to F) show the construction of a four bight three strand knot. This knot, if paralleled, would yield a knot similar in appearance to the two bight knot, see Fig. 3, page. 112. However, instead of paralleling the single thong structure (which yields a knot having the appearance of those shown in Figs. 3-4-5-6 or Fig. 6K, page 113 if paralleled twice) the fourth strand is woven into the three strand structure as shown in Fig. 10G. The left hand sketch indicates by the arrow marked line the path of the thong. The right hand sketch shows the thong in place.



The principle follows—The fourth strand is woven into the three strand structure by crossing over two and under one.

Sketches 10 (H and K) show a continuation of this principle which applies only to the laying in of the fourth strand. The left hand sketch of Fig. 10L indicates the path which the fifth and last strand takes. The right hand sketch shows the thong in place.

The principle follows—The fifth strand is woven into the four strand structure by crossing over two and under two. Sketch 10M shows a continuation of this principle. The knot will be complete when the thong is passed through the structure as indicated by the arrow marked line sketch 10N. After removing all slack and rolling the knot, trim the thong ends off close to the strands from which they emerge.

This knot has several applications. Fig. 14 shows it used on each end of the multiple thong knot, and the adjustable fastening of the bridle, detailed on page 137.

Fig 14

This knot is very ornamental and possesses great strength when made compact. It makes a very serviceable and ornate band for a Bow Grip of plaited thong or wrapped cord construction, also for Handles of Canes, Umbrella, etc.

Multiple Thong Knot

In the construction of the preceding knots it will be noticed that a single thong has been used to form the structure, which may be paralleled once or twice to give the desired strength or appearance. The two bight knot shown in Fig. 5, page 112, may be made any desired length by increasing the number of spiral wrappings (Sketch 5A) and when finished has the appearance of a strand of our four plait round. See Fig. 7, page 107.

Multiple thong knots having the appearance of plaited strands made of 12-16-20 or more thongs may be constructed in any desired length from one half the number of thongs appearing in the finished knot.

The diameter of the core may vary in size from a small to a large diameter and yet be completely covered by thongs of uniform width, see Fig. 9. Compensation for this variation in core size is found in the slope angle of the interwoven spiral thongs. Referring to Fig. 9, it will be noted that the slope angle at the greatest core diameter approaches the horizontal while at the smallest core diameter it has shifted toward the perpendicular. In knots where the core diameter is uniform the slope angle of the thongs will remain constant.

Sketches 9 (A to S) show construction details of a multiple thong (twelve plait) knot made from six thongs. Sketch 9A shows the thongs tightly seized about one-half inch from the ends with a strong thread or small twine and securely fastened to the core. Sketch 9B shows how the six thongs are distributed about the core The thongs have the flesh side out.

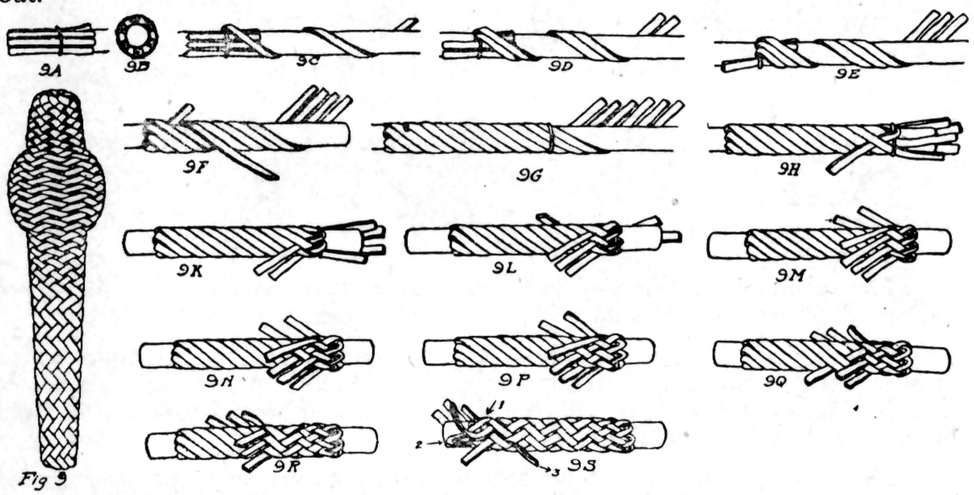


Fig 9

I. Each thong in turn is laid back over the seizing twine and wound in a spiral path around the core for the desired length. Sketches 9 (C-D-E-F) show this operation for five thongs. After the sixth thong is wound into the remaining space and all thongs are twisted so that they cover the core completely they are seized to the core at a point to give the desired length as shown in sketch 9G.

II. Each thong in turn must be laid back over the seizing twine and the process is that of interweaving each thong into the spiral wrapped core. Sketches 9 (H to M) show the appearance of the work as each thong is started on the return trip. Four of the six thongs have been started back as indicated in Sketch 9M.

The interweaving process affords an opportunity to work out many design patterns and changes are easily made from one to another.

The over one and under one weave yields the design shown in Figs. 13-14-15, page 137.

The over two and under two weave is shown in Fig. 16.

The over three and under three weave is shown in Fig. 10.

The Gaucho Knots

The three knots shown below were developed from a piece of plaited work made in South America. The method of tying them was obtained from Bernard Prichard, a native son of the Argentine, whose grandfather, an English immigrant, was associated with that great Italian soldier of fortune, Garibaldi. These knots were in use then by the Gauchos or cowboys who roamed the great plains or pampas, the cattle country of the southern continent.

The Gaucho knots are useful for terminals, adjustable fastenings or sliding knots, also for ornamental purposes. The knots are usually formed over a tubular piece of leather that has been sewed together with waxed thread. The thickness of the leather affords an edge which holds the thong in place during the construction of the knot.

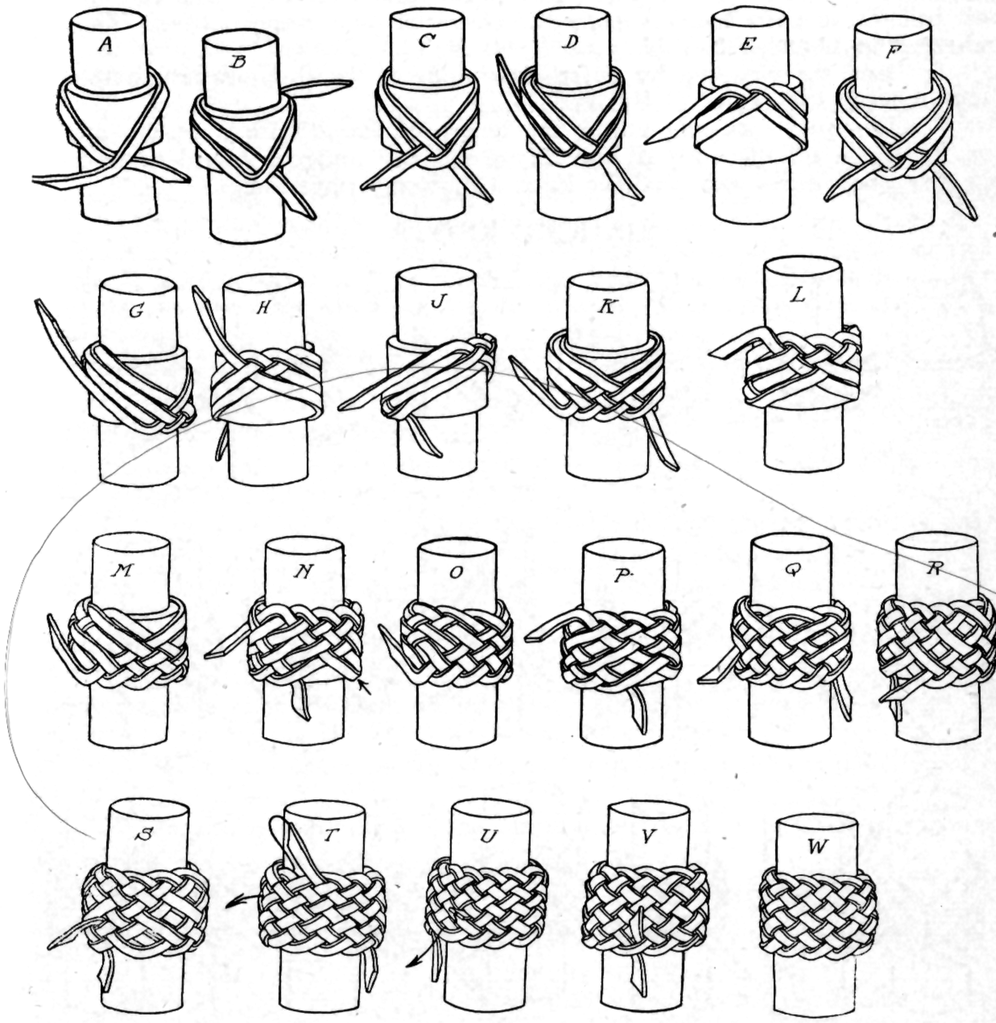


Fig. 40

I—The Single Gaucho, Basket Weave Patterns

The formation of this knot is shown in Fig. 40, Sketches A to W.

1. Make a diagonal loop around the core as indicated in Sketch A.

2. Carry the thong across the end and parallel the loop following upward on the lower side, see Sketch B.

3. Cross the thong over the first loop and parallel it downward on the upper side, see Sketch C.

4. Repeat the operation, **paralleling on the lower side** of the thong structure **when following upward** and after the cross-over (see Sketch E). Continue **paralleling on the upper side** (see Sketch F) **when following downward.** The design followed is the basket weave or over-one, under-one pattern.

5. Continue the weaving process until the entire core is covered. The appearance of the knot just prior to paralleling for the last time is shown in Sketch R. It will be noticed that the space between the first and last thong will be filled by the addition of a single thong. Also the thongs crossing this space are alternately under-two and over-two. The last thong will split these pairs and complete the over-one, under-one pattern. This is indicated in Sketches S-T-U.

6. End the weaving by making the ends of the thong secure with the junction near the center of the knot.

7. Remove slack and adjust the length of loops with a marlin spike.

8. Trim off the ends of the thong and roll under a board to smooth out any unevenness and give the knot a uniform appearance.

GAUCHO KNOTS

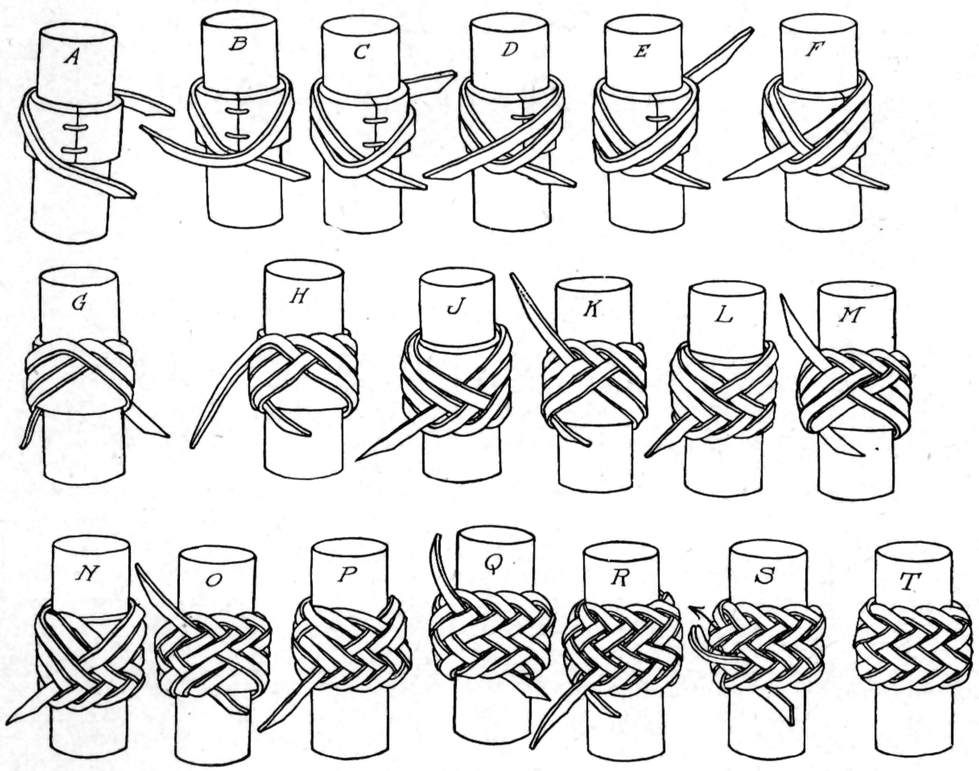


Fig. 41

II—The Double Gaucho, Herring Bone Pattern Single

The formation of this knot is shown in Fig. 41, Sketches A to T. The principle is similar to that described for the single Gaucho except the pattern of the weave is **over-two, under-two instead.**

1. Make a diagonal loop around the core as indicated in Sketches A and B.

2. Parallel upward on the lower side of the thong as shown in Sketch C.

3. Cross over the thong and parallel downward on the upper side of the thong as shown in Sketch D.

4. Cross over two thongs and parallel upward as shown in Sketch E.

5. Cross over two thongs as shown in Sketch G and parallel downward as indicated in Sketch F.

6. Pass the thong under one and over two as indicated in Sketch F.

7. Parallel upward, pass the thong under one and over two as shown in Sketch H.

8. Parallel downward, pass the thong under two, and over two as shown in Sketch J.

9. Parallel upward, pass the thong under two and over two as shown in Sketch K.

10. Parallel downward, see Sketch L, then upward, see Sketch M. Notice the thong passed over one, under two, and over two. **The thong must emerge and cross over two thongs.** Hence on the first, third, fifth, and succeeding odd number of turns the thong crosses either under or over a single thong, whichever is required to make it emerge and cross over two thongs. See Sketches P-Q, the thong passes under one, over two, under two over two.

Continue the paralleling and weaving process until the core is covered.

11. Fill the space between the first and last thong, Sketch Q. Sketch R shows this step complete.

12. End the weaving by making the ends of the thong secure with the junction near the center of the knot.

13. Remove slack and adjust the length of loops with a marlin spike.

14. Trim off the ends of the thong and roll under a board to smooth out any unevenness and give the knot a uniform appearance.

III—The Triple Gaucho, Herring Bone Pattern Double

The formation of this knot is shown in Fig. 42, Sketches A to Z. The principle is similar to that described for the Double Gaucho except the pattern of the weave is over-three, under-three instead.

1. Make four diagonal loops around the core as indicated in Sketches A to F.

2. Parallel downward on the upper side of the three loops as shown in Sketch G.

3. Cross under one thong and over three thongs, Sketch G.

4. Parallel upward on the lower side of the three loops and cross over them as indicated in Sketch H.

Sketch I shows the completion of another loop and the thong passing under one thong and over three thongs. The sketches J and K show the completion of another loop and the thong passing under two thongs and

over three thongs. Sketches L and M show the completion of the next loop and the thong passing under three and over three thongs. Sketches N and O show the next loop completed and the thong passing over one thong, under three, and over three thongs. Sketches P and Q show the next loop completed and the thong passing over two thongs, under three and over three thongs. Sketches R and S show the next loop completed and the thong passing over three, under three and over three thongs. Sketches T-U show the loop made by passing the thong under one, over three, under three, over three.

Sketches V-W—Thong passes under two, over three, under three, over three.

Sketches X-Y—Thong passes under three, over three, under three, over three.

This completes the knot.

5. End the weaving by making the ends of the thong secure with the junction near the center of the knot.

6. Remove slack and adjust the length of the loops with a marlin spike.

7. Trim off the ends of the thong and roll under a board to smooth out any unevenness and give the knot a uniform appearance.

Any of the Gaucho Knots make attractive Neckerchief slides and when formed over a ½" or ⅝" dowel will be sufficiently large to slide readily over the ends of a scarf or Neckerchief.

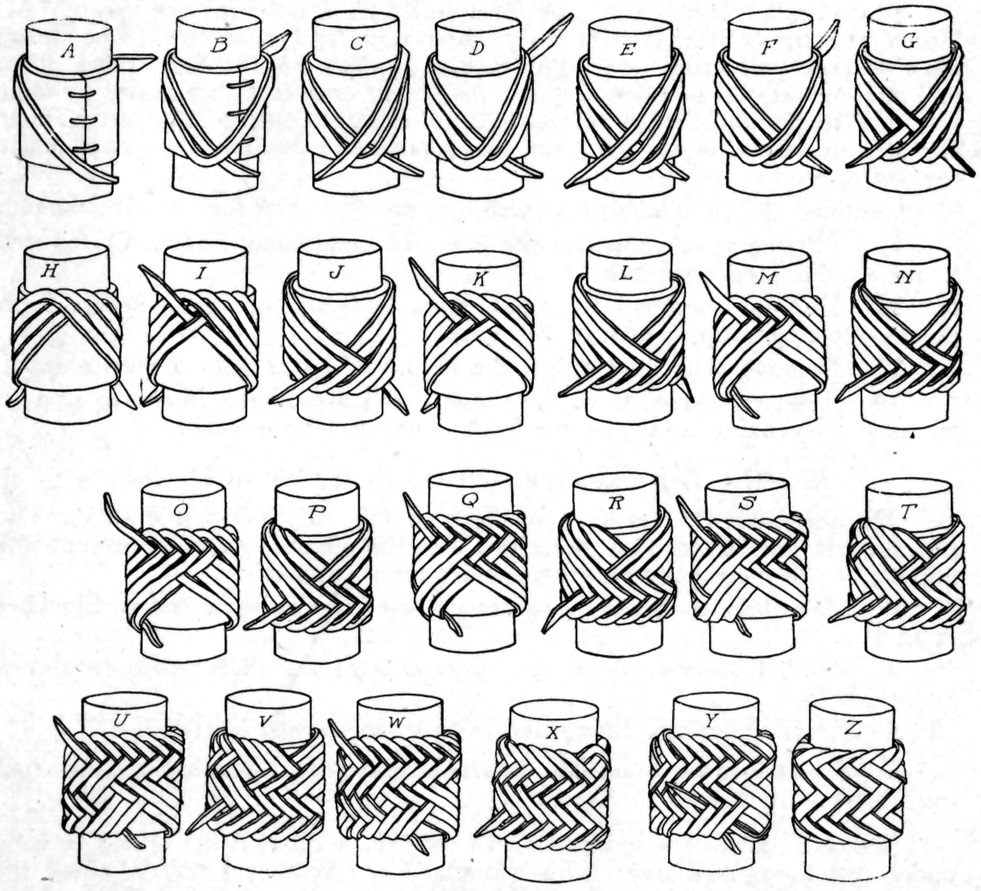
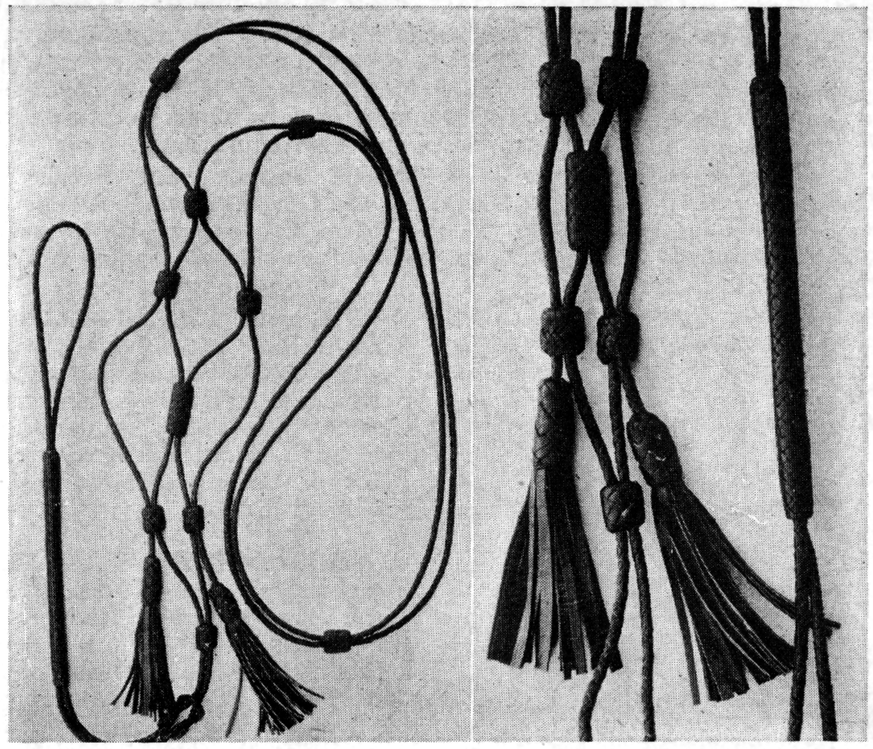


Fig. 42



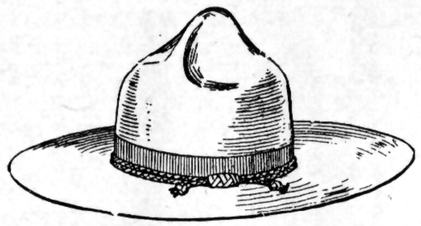
A B

Fig. 43

PLAITED LANYARD WITH GAUCHO KNOTS

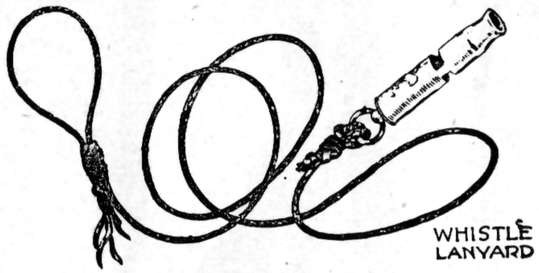
The lanyard shown in Fig. 43, Cut A, is made of a strand of four plait round. The middle point of the strand, also both ends are at the bottom. This makes the lanyard double and it is adjustable through the use of the sliding Gaucho Knots. An extension loop is attached to the lower loop formed at the middle point of the strand. The extension loop is made into a single strand at the center by plaiting over the double strands a four plait structure and weaving the ends back as detailed in the specifications for Quirt C. The Cut B shows in larger detail the appearance of the central portion of the extension loop, also the tassels and several of the Gaucho Knots.

Specifications


HAT BAND

Hat Bands—Single Strand: Cut thongs from two 3″ discs. Make a strand of four plait round 28″ to 30″ long. Finish both ends with the Terminal Turk's head. Roll with foot or under a board. Form loop and tie Sliding Knot. Page 111.

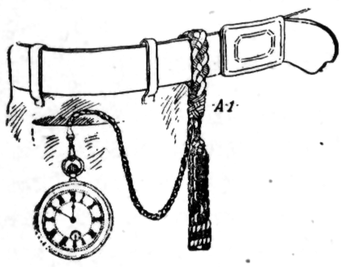
Double Strand: Cut thongs from two 4″ discs. Make strand of four plait round 48″ to 52″ long. Finish as specified for the single strand Hatband. Form double loop and tie Sliding Knot.


WHISTLE LANYARD

Whistle Lanyard—Cut thongs from four 3″ discs or two 4″ discs. Make strand of four plait round 4′ to 5′ long. Finish both ends with the Terminal Turk's Head. Roll with foot or under a board. Form double loop and tie Sliding Knot.

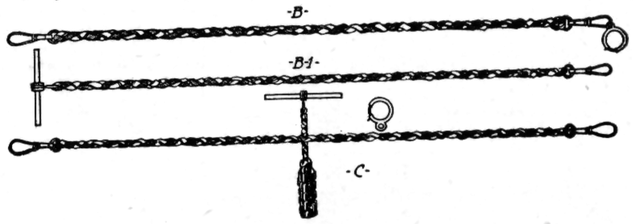

NECKERCHIEF TURKS HEAD

Neckerchief Turk's Head—Cut thongs from two 3″ discs for a double Strand Turk's Head or from two 4″ discs for a Triple Strand Turk's Head. Make a strand of four plait round. Finish both ends with the Terminal Turk's Head. Roll with foot. Form the Neckerchief Turk's Head as illustrated on page 115.


-A1-

Watch Guard A1—Cut thongs from two 2″ discs. Insert thongs in ring of swivel; find center of thongs; make a strand of four plait round, about 8″ long; change to four plait flat. Continue the flat plait for a length of about 2″. Tie the Terminal Turk's Head. Finish with Crown on Crown work. An attractive ending is produced by forming eight crowns square, eight crowns spiral, and eight crowns spiral reverse, as illustrated in Guards and Fobs A, A1, C, D, and E. Terminate by tucking the ends under and trimming off as shown in Figs. 12 and 13, page 109, for producing the Four Plait Square. Form belt loop and tie Sliding Knot.

Watch Guards B, B1, C—Cut thongs from two 2″ discs. Insert thongs in ring of bar, spring ring, or swivel; find center of thongs; make a strand of four plait round, about 10″ or 12″ long. Insert one thong of each pair of thongs in the ring of another swivel. Splice each of these thongs into the plaited strand by removing one thong at a time and



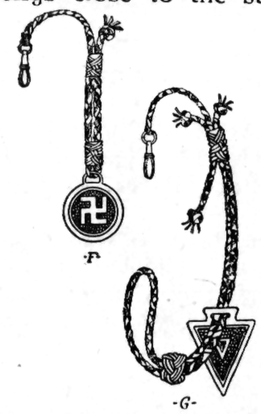
following up each receding thong with the splicing thong for about 2″. This makes the fastening at each end the same without the bulk of a Terminal Turk's Head. Overlap the receding thong with the proceeding or splicing thong. Roll under foot or with a board and cut off the ends of the protruding thongs. See Sketches B and B1, page 128.

Guard C is a variation of guard B and made with a swivel on each end to which has been added a strand of four plait round which is spliced into the horizontal strand at the middle point. Separate the thongs of the horizontal strand; insert the thongs attached to the ring in the bar or spring ring fitting; continue plaiting four plait round for about 1″. Tie the Terminal Turk's Head. Finish with Crown on Crown work as in Guards A, A1, C, D, and E.

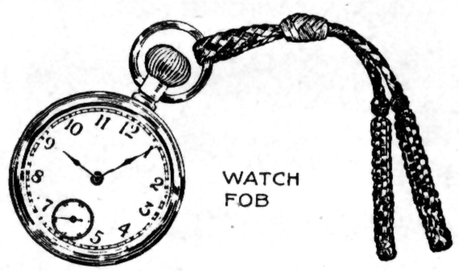

-A-

Fob D—Cut thongs from two 2″ discs. Insert thongs in ring of swivel, find center of thongs. Make a strand of four plait round for about 2″. Change to four plait flat for about 2″; change back to four plait round for about 2″. Tie the Terminal Turk's Head. Finish with Crown on Crown work. Tuck ends under and trim off thongs close to the strand.


-D-


-F-

-G-


WATCH FOB

Watch Fobs—Fob E: Cut thongs from four 2″ discs or two 3″ discs. Tie an overhand knot at the center of the thongs. Make a strand of four plait flat 1″ long. Change to plait of four round for a 2½″ length. Tie the Terminal Turk's Head. Continue with four plait square for eight crowns. Change to four plait spiral or spiral reverse, for eight crowns. Terminate by tucking the ends under and trimming off. Untie overhand knot and repeat these specifications. Tie Sliding Knot. Remove ring from watch. Place fob on ring and replace ring.

Fobs F and G—Show methods of attaching a pendant to a strand of four plait by means of the sliding knot as in Fob F.

Fob G shows a method of fastening a pendant by means of slipping a loop over a Terminal Turk's Head and slipping a sliding knot up under the Terminal Turk's Head to hold the loop fast. This is a type of adjustable fastening used in attaching bridle and bridle reins to the bit.

Dog Leash—Cut thongs ⅛″ wide from two 4″ discs or use four 8 foot thongs 3/16″ wide, Latigo leather. Plait a strand of four plait round over a core ⅛″ in diameter, slip one end of strand through the ring of a dog leash swivel. Tie a Terminal Turk's Head on both ends and secure with sliding knots as illustrated in whistle lanyard, page 102 and 128.

Specifications Plaited Bridles, Bridle Reins and Quirts

The bridle reins shown in the photograph below are of the continuous type, and plaited over a core of woven clothes line. The ends are finished with loops that may be attached to swivel snaps or to an all leather

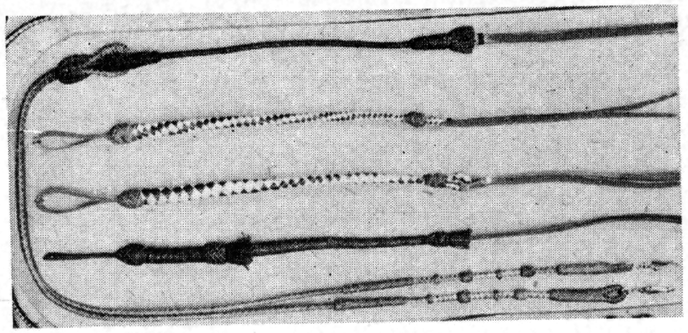


Fig. 44

fastening of the sliding knot type. The detail for attaching bit to bridle is shown in Fig. 13, page 136. The type of quirt used on the continuous rein is shown in Fig. 44, No. 15, also by the enlarged detail, Fig. 45, No. 16.

The majority of the plaited reins are continuous and are joined to a quirt end as indicated in Fig. 15, which shows another splice covered by a multiple thong knot. In Fig. 16, page 136, the detail for ending the quirt is given. In Fig. 14 an ornamental knot is illustrated.

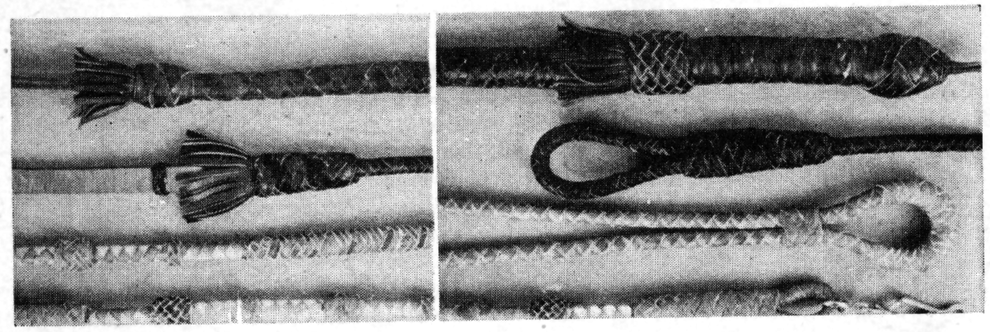


Fig. 45

Two types of plaited Quirts are shown in Fig. 44. Those shown in black and white design are made up of four and six plait respectively. The thongs have been tapered to correspond with the tapered core, and beveled to present a smooth appearance when rolled. The core of this type of quirt is made of strips of rawhide and strap leather wrapped with twine. Detail is given on page 131, quirt A.

The quirt shown in Fig. 45, No. 21, is made over a core composed of a tapered leather bag, filled with buckshot and stiffened slightly in the handle. Quirt B, page 131. The plaiting is accomplished by the weaving process, which is shown in multiple knot, page 122, and quirt details, page 132.

Specifications—Quirts

Quirt A—Beveled and Tapered Thong Type. (Four Plait Round.)

Tools: Thong Knife, Marlin Spike.

Materials: Four Latigo Thongs, tapered 5/8" to 1/4"—40" long. One Core, Rawhide and Strap Leather Strips, One Hand Strap, One Lash Strap, Two Thongs for Knots, Twine.

Instruction:

1. Soak the rawhide strips in water until they are soft and pliable.

2. Wrap the rawhide core with twine about an eighth of an inch apart for the full length. See Sketch A. Stretch the wet core out straight and permit it to become thoroughly dry. A good way to dry the core is to drive a nail through the core into a timber, and hang a weight from the lower end. See Sketch B.

3. Attach the handle strap, Sketch B, to the core, also strap, Sketch C, which conceals the end of the core and passes between the handle strap as shown in Sketch D. The handle strap is secured in position by lashing with stout twine.

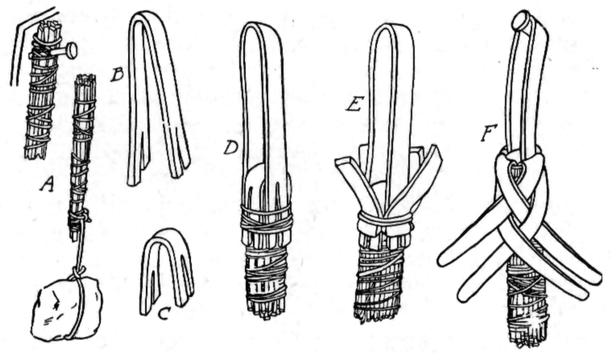


Fig. 27

4. Plait the tapered thongs over the core. See plaiting illustration, page 106. Tie the upper ends of the thongs with twine as shown in Sketch E. It will be noticed that the thongs are placed against the core with the flesh side out. After securing the thong ends to the core, place the hand strap loop over a nail or other support and start the plaiting as shown in Sketch F.

5. End the plaiting by turning the tapered strand up at the end in the form of a loop, and seizing it with a few turns of stout twine. See Sketch H, Fig. 28, page 132.

6. Tie the knots at the top and bottom of the quirt. Insert the lash strap and tie the sliding knot to secure the lash strap in position. See sketch and detailed specifications for the knot at the top of quirt, page 113, Fig. 6. For lower knot see the single Gaucho knot, page 124.

Quirt B—Uniform Width of Thong Type. (With Shot loaded handle and twelve plait round lacing) Fig. 28, page 132.

Tools: Thong Knife, Marlin Spike, Needle and Awl, Leather Thimble.

Materials: 15 yards 1/8" Thong, Shot Bag, Knot Fringe, One Hand Strap, One Lash Strap, Three Thongs for Knots, Twine.

Instruction:

1. Preparation of the core. Pour birdshot into the tapered sack made of soft leather, firm cloth or canvas. Sketch A, and around the pieces of strap leather which are inserted to stiffen the quirt handle.

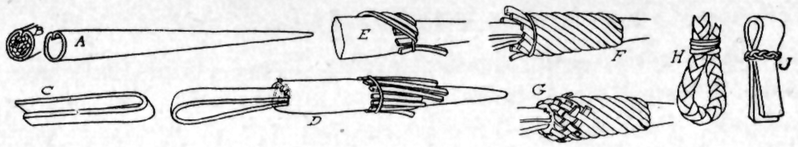


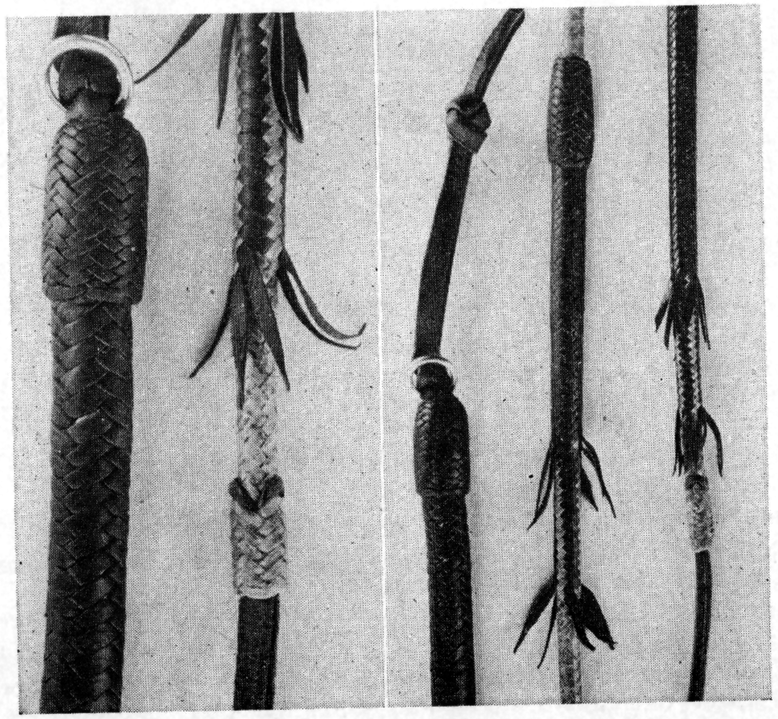
Fig. 28

2. Insert the handle, Sketch C, into core sack, Sketch D. Close the end by sewing the edges of the sack together. Stitch through the handle strap using an awl to secure it to the core. Roll the core to distribute the shot, and produce a smooth surface shown in sketch D.

3. Weaving the handle. Start at a point about 5″ from the top. sketch D. Secure six ⅛″ thongs 30″ long flesh side out by twine wrapped around both core and thongs, sketch D. Fold these thongs over the seizing twine, sketch E, and wrap them spirally over the core, to the upper end of the handle, sketch F. Again hold the thongs in place with a piece of twine. The thongs are doubled back over the twine and woven into the spiral, sketch G, wrapping as described under the construction of woven strands, page 122.

4. Weaving the quirt body is done in the same way as described above for the handle construction. Again secure six ⅛″ thongs, 48″ long to the core with twine, fold them over the twine, and wrap around the core closely (all thongs touching each other) to the extreme end of the core. Secure these as before and weave the thongs back to the handle.

5. Form the lash strap loop, Sketch H, described in the instruction given for making Quirt A. Attach the lash strap, Sketch J, and tie the knots. Another appropriate knot for concealing the junction of the quirt handle and body is shown in detail in Sketches A to G, page 113. This may also be tied with a single wide thong. See photograph on page 130, and Figs. 10-11-12, page 137 for other styles of quirt handle straps.



A B

Fig. 30

Quirt C—Rawhide Thong Type.

The quirt shown in Fig. 30B, page 132, is a masterpiece in thong plaiting. It was designed by Jim Breslin, cattleman and craftsman who has acquired much skill in primitive handicrafts from various contacts made while a cowboy on the range. The quirts shown in Fig. 30 are made of rawhide thongs plaited over shot loaded cores. The quirt shown in Cut A is a twelve plait while the one shown in Cut B is a sixteen plait. The method used in making this style of quirt is given under the specifications for Quirt C. A stiff handled quirt is made by inserting a piece of hardwood doweling, or a metal rod into the upper part of the shot bag.

Tools: Thong Knife, Marlin Spike, Needle and Awl, Leather Thimble.

Materials: Rawhide Strip, 1¼″x48″, split into six thongs. Calfskin Thongs, Shot Bag, Hand Strap and Ring. Lash, Thong for End Knot, Waxed Thread.

Instruction:

1. Core Construction. Cut a piece of firm leather 16″ long and taper from 1″ to ¼″. Fold the leather to bring the edges together and join by sewing with a waxed thread. Place No. 12 shot into the bag to fill the tip to a depth of about 4 inches. Pack the shot with a wire tamper. Continue to add shot (size No. 10) and tamp with wire or rod. Tie both ends of bag with string and roll under a board. The handle strap is inserted and sewed in place as indicated in Sketch A, Fig. 30.

2. Soak the rawhide in water until soft. Fold the rawhide strip around the core and tie with string in the position shown in Sketch B, Fig. 31.

3. Plait a strand of six plait round upon the core using the basket weave pattern (over one and under one) as indicated by Sketches C to L. After the core is covered weave the thongs back into the six plait structure to form the twelve plait covering. The weaving process is shown in Fig. 32, Sketches M to T. After each thong is woven back into the plaited strand the thong arrangement is an over two, under two design pattern.

In Sketch M the start of the weaving back process is indicated by the arrow. The appearance of the strand after one thong has been woven back is indicated in Sketch N. It will be noticed that the thong **parallels a thong** in the plaited structure **on the upper side.** See the indicating arrows

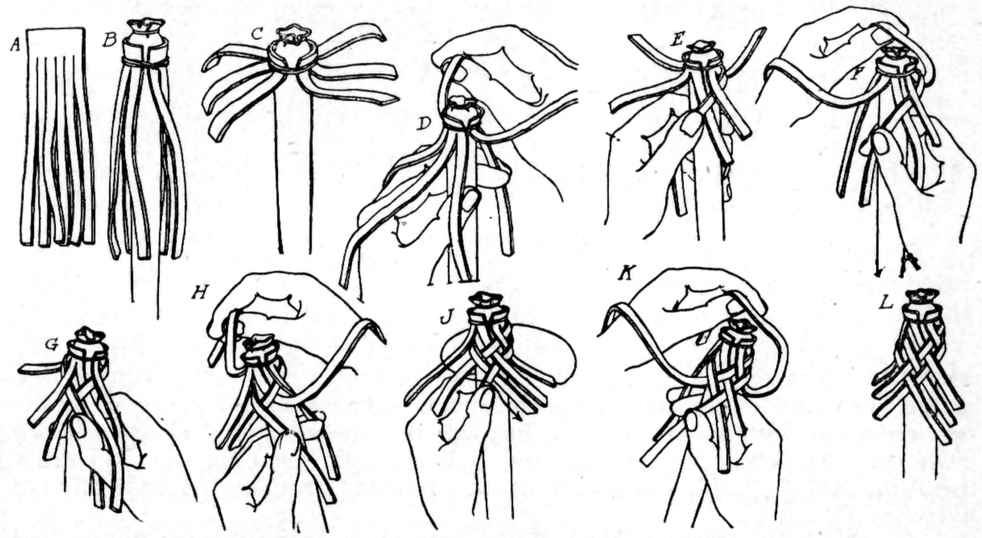


Fig. 31

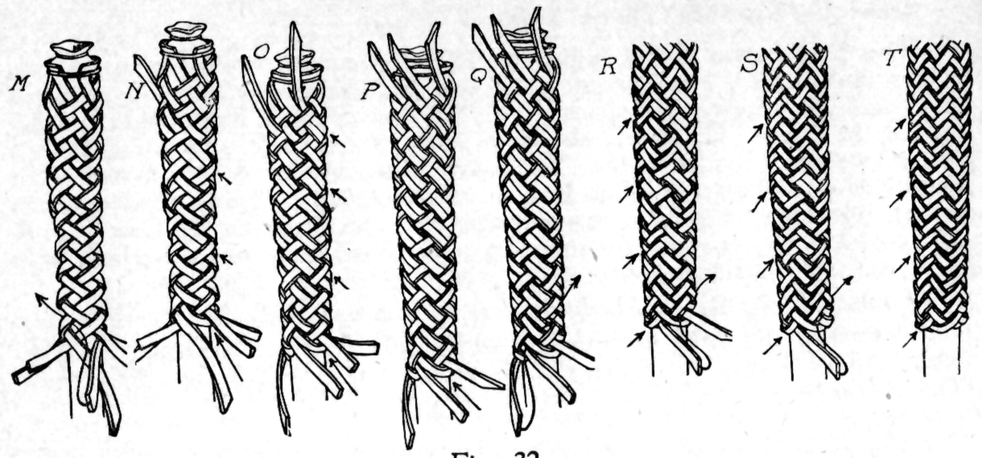


Fig. 32

in Sketch N, which shows the parallel thongs. Sketches O-P show the weaving back process for the three thongs which revolve in a left hand spiral path. Sketches Q-R-S show the start of the weaving back process for the thongs which revolve in a right hand direction. It will be noticed that these thongs **parallel thongs** in the plaited structure on **the lower side.** Also they **split pairs** of parallel thongs and form the over-two, under-two design pattern. Sketch T shows the appearance of the finished plaited and woven strand.

4. Cover the plaited rawhide with calfskin thongs by weaving them into the strand as indicated in Sketch B, Fig. 30, page 132. A decorative effect is obtained by cutting the protruding thongs to a taper.

Moisten the rawhide thongs and wrap securely with twine.

5. Tie a terminal knot to conceal the ends of the rawhide thongs. Knots shown on page 113 and 124 are appropriate for this purpose.

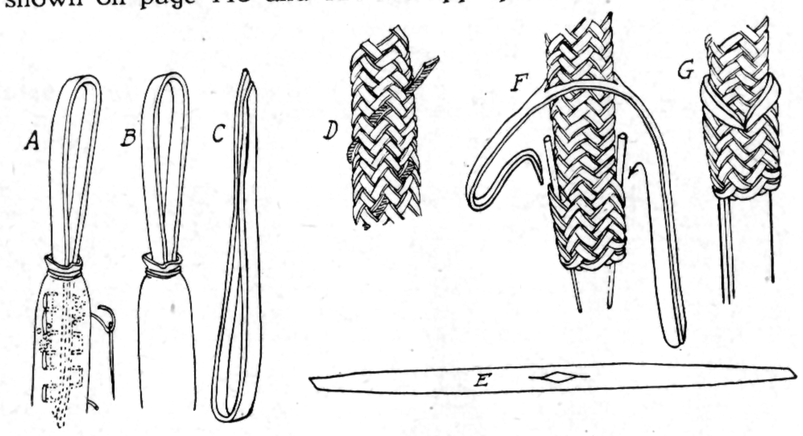


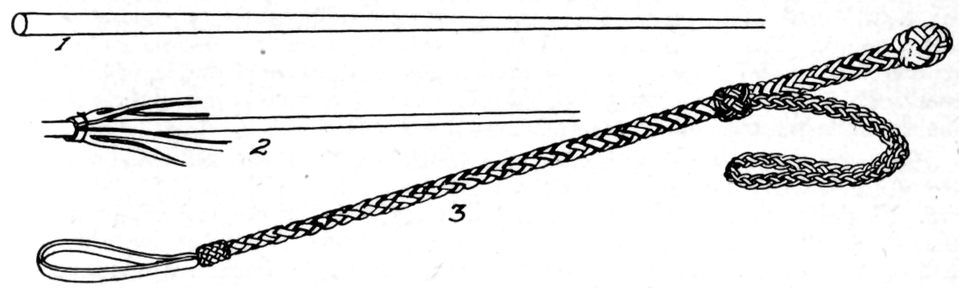
Fig. 33

6. Insert the lash (see Sketch E, Fig. 33) by passing the end of the quirt through a slit cut in the center of the lash. See Sketch F. Dip the end of the quirt into water and soften the rawhide as shown in Sketch F. Make two openings with a marlin spike through the plaited strand about an inch from the end. Pass the ends of the lash through the openings and draw them out through the open end of the plaited structure as indicated in Sketches F and G.

7. Mold the moist rawhide thongs around the lash with the fingers and hammer (gently) into shape. Permit to dry and the quirt is ready for use.

Riding Crops

The riding crop illustrated in Sketch 3 is made by plaiting four or six tapered thongs over a solid rawhide core according to the directions given on pages 106 and 117.

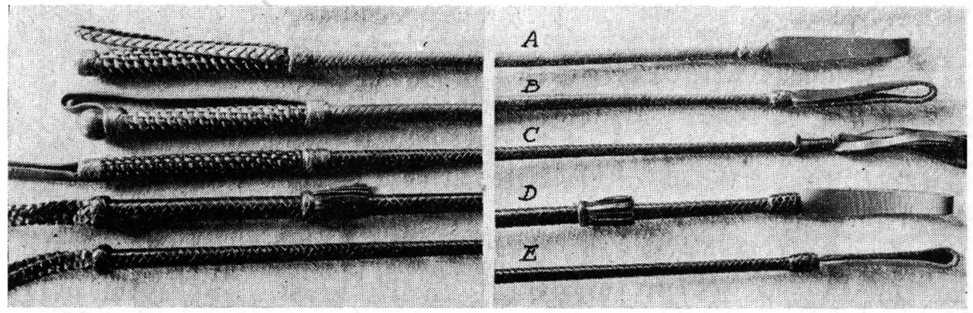


The upper end is covered by a unit length three bight knot. See page 113. The hand strap may be made with thongs, four plait flat, or from a single piece of light weight strap leather.

A method of attaching the hand strap is to seize the ends to the body of the crop by wrapping them with strong twine. A five bight turkshead knot, page 115, is suitable for covering the joint made with the twine.

The end strap is also seized with the cord to the end of the crop. This joint may be covered with a two bight knot, see page 113.

Several variations in the method of attaching hand strap to crops are shown in the accompanying photograph, illustrations A to E. The hand



strap, illustration A, is attached as described above. The crop shown, photograph B, has a hand strap which is attached at two points: One end is fastened under the knot at the lower end of the handle. The other end is attached to the upper end of the handle also by another knot. The riding crops, C, D and E, have the hand strap attached to the upper end of the body in quirt fashion.

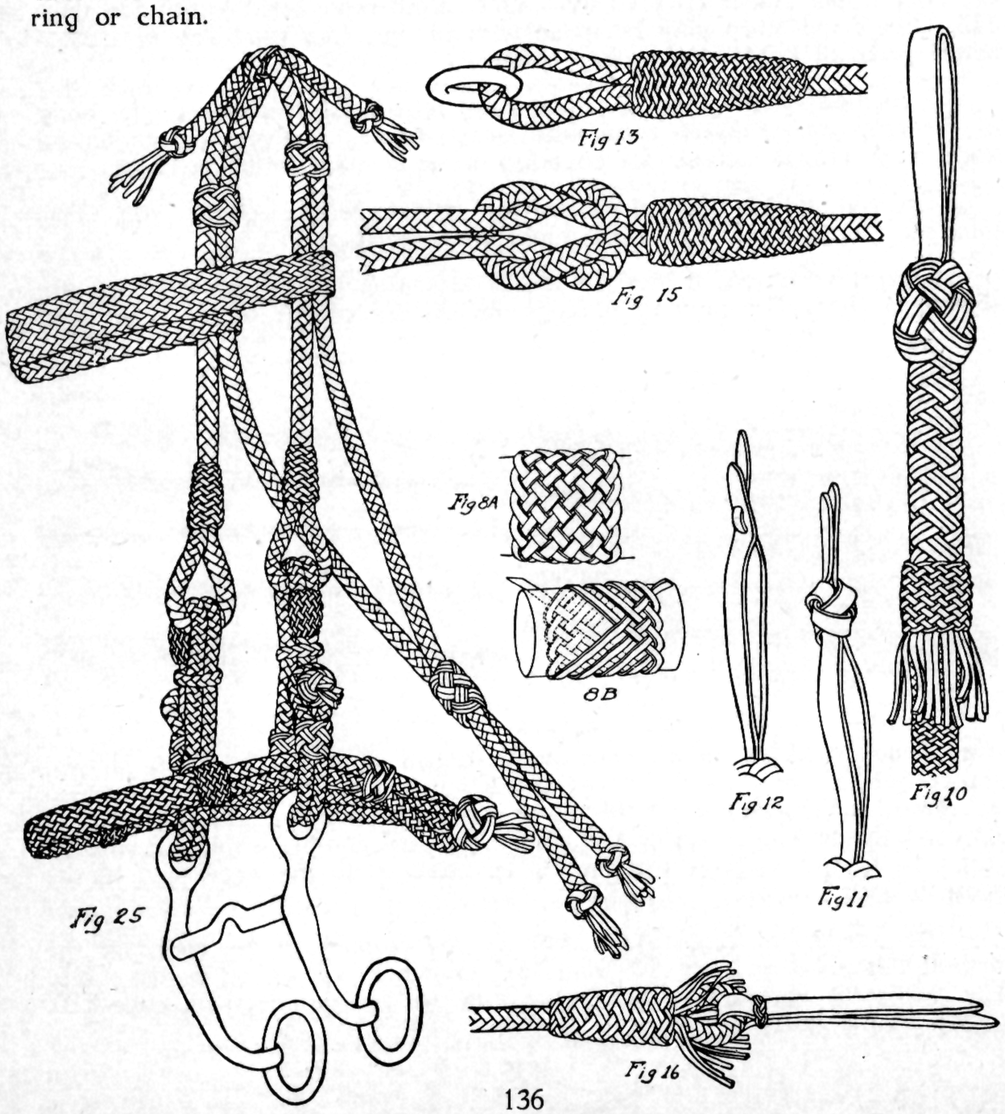
The handles of crops A, B, and C, are formed on the cores by the method described on page 109 and 110, known as crown on crown work. The particular variation of this process is the one described on page 110, known as the spiral reverse.

Plaited Bridles, Reins, and Quirts

The construction details for plaited Bridle Reins, and Quirts shown in the accompanying sketches are typical of those to be found in use on the ranches in the Southwest.

The Bridle, Fig. 25, shown below, may be used with or without the bit. It is made adjustable for length by shifting the sliding knot on the top of the head piece. The throat latch is also made adjustable by means of the sliding knot. The bit is attached to the cheek piece by means of a loop which slips over a turks head knot on the end of a strand and is tightened up around the strand behind the knot by means of sliding knots. See detail in photograph of bridle reins. Page 131.

Several methods of attaching the bridle reins to the bit ring or chain are used. Two common methods are indicated in the Figs. 13 and 25. In Fig. 13 the plaited strand is passed through the bit ring or chain and is lashed to itself with strong thong (wet rawhide twine or wire). This lashing is then covered by a woven thong knot, the construction detail of which is given page 123. The same type of fastening used to attach the cheek of the bridle to the bit is often used to attach the reins to the bit ring or chain.



Single Thong Multiple Bight Knot

This knot is illustrated in Fig. 8 to the right of the plaited bridle, Fig. 25. Sketch 8B shows the principles of construction. The knot is completed by continuing the weaving process until all space is filled. This knot is frequently used on quirts at the junction of the handle with the tapered section, see Fig. 10, page 136. This knot is the single gaucho tied without a core.

In Fig. 10 a quirt handle and strap are illustrated. Two methods of fastening quirt handle straps are indicated in Figs. 11 and 12. Fig. 11 shows two strap Turkshead detailed on page 80. In Figs. 12 one strap is run through two slits in the other strap.

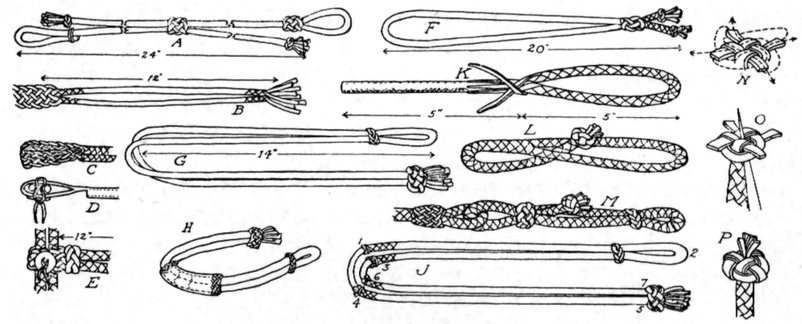


Fig. 26

Headstall—Plait two strands of four plait round, 28" long over a woven sash cord core. Form a loop as described under bridle rein, Fig. 26, sketch A, on one end and a terminal turks head on the other. See sketch A. Use eight 1/8" thongs 45" long, and a 3/8" sash cord core 28" long.

Throat Latch—Plait a strand of 6 plait round 40" long, over a sash cord, sketch F. Tie a terminal turks head on each end.

Browband—Plait two strands of 4 plait round 12 inches long, sketch B over a woven clothesline core. Extend the plaiting 3 inches beyond each end of the core. Use the thongs from each strand to make an eight plait flat strand. Carry the flat plaited portion around the cheek and throat latch strand, sketch D, and secure the thongs as indicated in sketch C—partially by splicing the thongs back into the strand, and seizing the splice with twine. Conceal the junction with the knot shown in Sketch H, Fig. 6, page 113, using a single thong. After the assembly of the headstall, throat latch and brow-band, tie a sliding knot as illustrated on page 111 to hold the ends of throat latch together.

Use four 3/16" thongs 30 inches long, two 1/4" clothesline cord 11 inches long, two conchas and strap.

Bosal or Nose Band—Plait a strand of 6 plait round 30" long over the sash cord core, sketches G and J, from point 1 around the loop 2 and back to point 3. Plait two strands of 6 plait round 14" long over the ends of the core. Sketch J, sections 4-5 and 6-7. Wrap the loose ends of thong at points 1-3 and 4-6 with twine and tie a twelve plait woven knot, 5" long, over the junction of these thongs as indicated, sketch H. See specifications for the Multiple thong knot, page 122.

Tie terminal turks head knots on both ends of the strand, also the sliding knot illustrated in Sketches A to H, Fig. 5A, page 113.

Use 6-3/16" thongs 30" long, 12-3/16" thongs 20" long.

Bit Loop—Plait a strand of 4 plait round over a woven cord core 1/8" diameter, 15 inch long, see sketch K, Fig. 26. Seize four thongs 3/16" wide to the core just beyond the middle point. Continue the plaiting to the end. Fold the plaited strand back to form a loop. See sketch L. Continue plaiting the thongs over the enlarged core to the end. Tie the crown knot and enlarge the Turk's Head as shown in Sketches N-O-P.

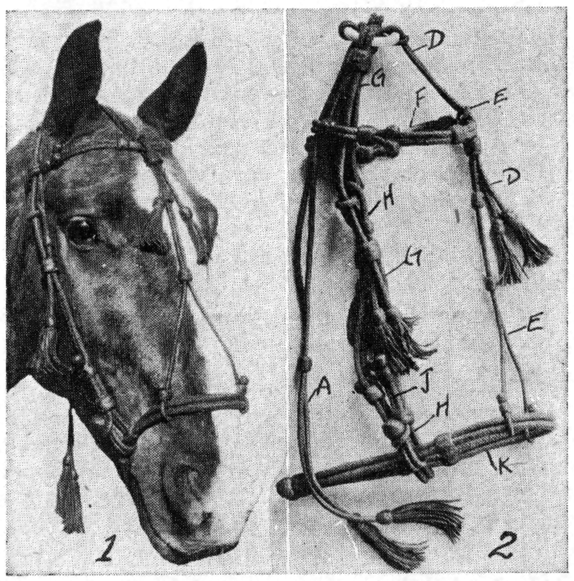
Use 4-3/16" thongs 24" long, core 1/8" shade pull cord 14" long.

Attach Bit loop to lower end of headstall as indicated in sketch M, seize the loop with twine at the point indicated and tie the turks head knot shown on page 115, with a single thong.

The assembly of the bridle is shown in Fig. 25, page 137.

Materials for Plaited Reins—Core; 9 feet braided Clothesline, Latigo thongs; four 1/4" thongs 8 feet long, eight 1/4" thongs 3 feet long for knot tying, 2 1-inch nickel rings.

Assembly. Wet the thongs in water before plaiting (They must not be wet enough for the water to ooze out). Start the plaiting of the reins at point A, the middle point of the rope core, and carry the plaiting to points B and C. Tie the ends of the thongs with twine to hold them in place. At points B and C, just beyond the ends of the thong, secure the ends of the four 3 foot thongs with twine and plait over the core from point B and C to the end. Pass the ends D and E through the inch ring and make a loop as shown in sketch F. Securely wrap with twine, wire or rawhide and cover with the Multiple thong knot shown on page 122, using 4 thongs instead of 6. At the points B and C, wrap the junction with twine to make it of uniform diameter and slightly larger than the diameter of the core, and plait thongs. Tie the knot shown in Fig. 5. See specifications in Fig. 5, Sketches A to F, page 112.



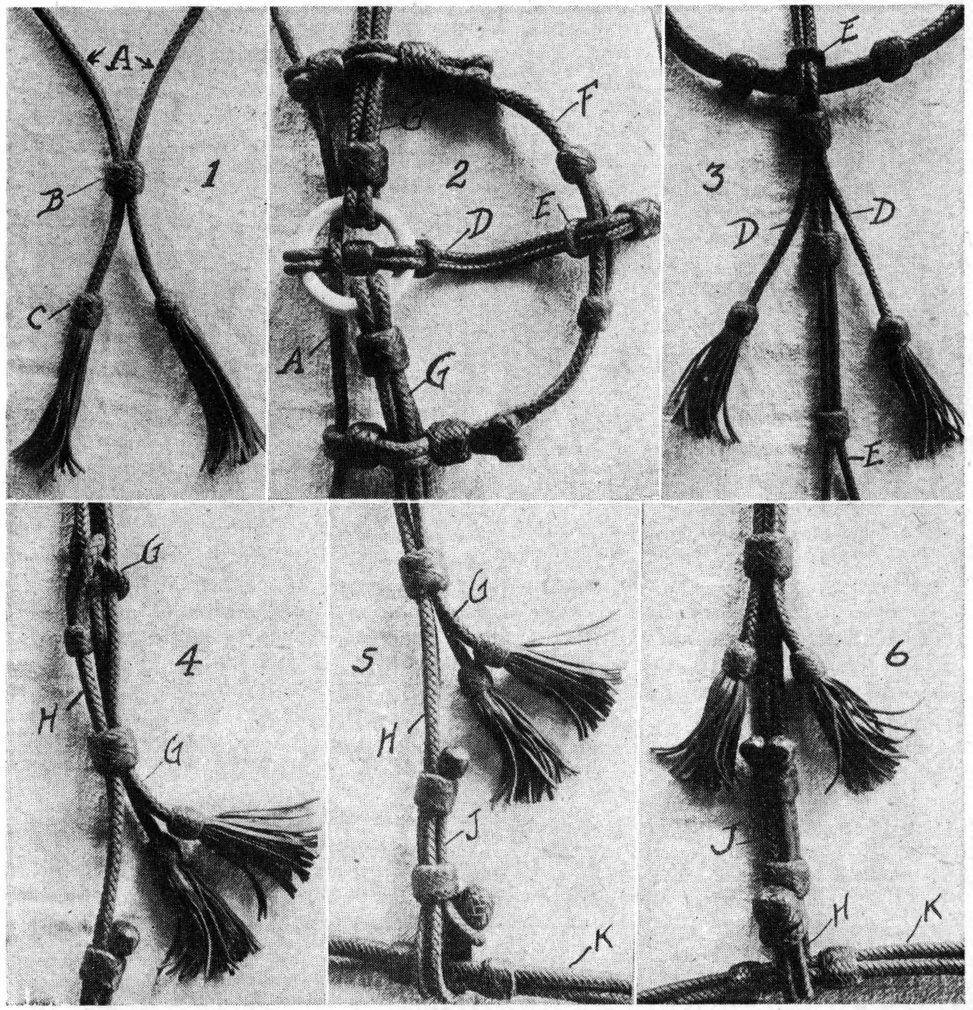
The illustration shows a ring type Hackamore bridle designed by Jim Breslin, the cowboy mentioned on page 133. Construction detail is given on pages 139 and 140.

Specifications. A—Throat Latch

Materials	Description
1—Core, 3/16" sash cord, 4' 6"	Plaited Strand—Four plait round, page 106.
4—Thongs 1/8" wide, 8' long	End Knots C, page 113. Knot B, page 126.
2—Thongs 1/8" wide, 3' long	
2—Pieces 1"x4" fringe	Tassel: Wrap end of fringe and thongs with string and sew with awl and wax end. Stitch core around both plaited strands.
1—Core for sliding knot, 1"x1/2"	
1—Thong 1/8" wide, 6' sliding knot	
1—Wax end thread	

D—Nose Piece

Materials	Description
1—Core 3/16" sash cord 3'	Plaited strand—four plait.
4—Thongs 1/8" wide, 6'	Sliding knot in center of ring, stitch core around the four plaited strands.
2—Cores for sliding knot, 1"x2"	
2—Thongs for sliding knot, 1/8"x8'	
2—Pieces 1"x4" for fringe	
2—Thongs 1/8"x3'	



E—Nose Piece

Materials	Description
1—Core, 3/16" sash cord, 3'	
4—Thongs, 1/8" wide, 6'	Plaited strand—four plait.
4—Cores, 1"x1½" strip	4 Sliding knots, page 126.
4—Thongs 1/8"x6'	2 End knots, page 113.
2—Thongs for terminal knots, 1/8"x3'	

F—Brow Band

Materials	Description
2—Cores, 3/16" sash cord, 26"	
8—Thongs, 1/8"x4'	Sliding knots around 4 plaited strands.
4—Cores for sliding knots, 1"x2"	
4—Thongs for sliding knots, 1/8"x8'	Sliding knots around 2 plaited strands.
2—Cores for sliding knots, 1"x1½"	
2—Thongs for sliding knots, 1/8"x6'	Terminal knots, pages 113-114.
4—Thongs for terminal knots, 1/8"x3'	
2 Plaited strands	

G—Cheek, Upper Portion

Materials	Description
2—Cores, ¼" cord, 4' long	
12—Thongs, 1/8"x7'	2 Strands, 6 plait, page 117.
2—Cores for knot, 1"x2¼"	2 Sliding knots around 4 plaited strands, page 126.
2—Thongs for knot, 1/8"x8'	
4—Pieces, 1"x4" fringe	2 Tassels
4—Thongs, 1/8"x3'	

H—Cheek, Lower Portion

Materials	Description
2—Cores, ¼" cord, 3' long	
12—Thongs, 1/8"x6'	2 Strands, 6 plait round, page 117.
6—Cores for sliding knots, 1"x2¼"	6 Sliding knots around 4 plaited strands
6—Thongs for sliding knots, 1/8"x6'	2 Sliding knots around 2 plaited strands
2—Cores for knots, 1"x1½"	2 Terminal knots, page 138, Fig. 26.
2—Thongs for knots, 1/8"x6'	Sketches N-O-P
4—Thongs for terminal, 1/8"x3"	

J—Loop, Lower Cheek

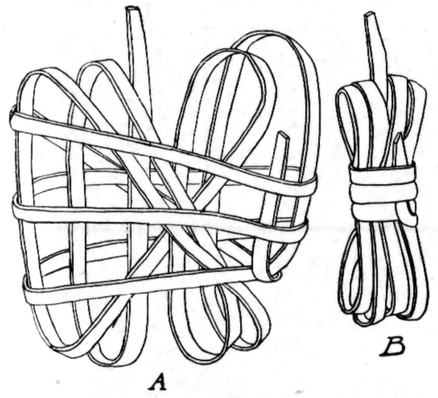
Materials	Description
2—Cores, ¼" cord 9'	2 Strands, 6 plait, page 117.
12—Thongs, 1/8"x16"	Terminal knots, pages 113-114.
4—Thongs for terminal knot, 1/8"x3'	

K—Nose Band

Materials	Description
2—Cores, ¼" cord, 9'	
1—Thong, 1/8"x5'	2 Strands, 6 plait
4—Cores for knots, 1"x1½"	4 Sliding knots around 2 plaited strands
4—Thongs for knots, 1/8"x6'	
1—Core for knots, 1"x2¼"	1 Sliding knot around four plaited strands.
1—Thong for knots, 1/8"x8'	
2—Thongs for terminal knot, 1/8"x5"	Terminals around both ends of each strand.

Numerous were the uses which the Indian and Pioneer made of rawhide. Shields of heavy rawhide were certain protection against flying arrows. Food storage bags, moccasin soles, ceremonial equipment, tom toms, rattles, travois and back packs utilized rawhide. Rawhide thongs and plaited strands, entered into the construction of rustic furniture, temporary and permanent structures. The early padres, mission builders, and ranchers of California, who used rawhide thongs for making laced seats in primitive furniture discovered a method of coiling the rawhide thong into a bundle of small diameter which passed through small meshes readily. This coil was called a "Tamale." From the center of the coil the user may feed out the amount desired without destroying its shape.

The tamale is formed by wrapping the thong around two supports as follows: Let your helper hold his forearms and hands horizontally out in front of his body, about a foot apart with thumbs and fingers extended, and his elbows at his sides. Tie the end of the thong to the thumb of his right hand, see Sketch A, drop the thong over his left hand, back under the right hand, over the right wrist (back of the thumb) across to the left hand again. Make another complete loop, encircling both hands, this time encircling the right hand in front of the thumb. Continue to encircle both hands with each loop, passing one loop in front of the thumb and the next loop back of the thumb of the right hand, until the entire length of thong has been wound around both hands. Use the last three feet of thong to bind the loop into a bundle as shown in sketch B. See page 270 for use with cord and yarn.



DESIGN OF RAWHIDE LACED FRAMES

The frame to be laced may be the top of a foot stool, bench, chair bottom or back, couch seat and back, bunk or bedstead. The "basket weave" or over one under one pattern is used in this design.

The procedure in laying out square and rectangular shaped frames is shown in the Figures 1 and 2.

1. **Make a Sketch of the Frame** in proportion, not necessarily to scale and locate the points on the edge as indicated in Sketch No. 1.

2. **Determine Mesh Size.** As a guide to lacing a chair seat about 17"x17" points may be spaced about two inches apart. This spacing will yield a mesh of about 1¼" size for a ¼" to ⅜" wide rawhide thong (thickness recommended 1/32" to 1/16"). Seven, eight or nine points may be used on a chair seat 17"x17" size. **Avoid an equal number of points on each side of the frame.** In case eight points are selected for the front and back "chair rails" use seven or nine for the side rails. The lacing pattern shown in Fig. 1 is developed for a six point spacing on the front and back rails and a seven point spacing on the side rails. These points are indicated on the frame outline in Sketch No. 1. The mesh pattern is visualized by drawing diagonal lines as indicated in Sketch No. 2.

Develop the Lacing Pattern

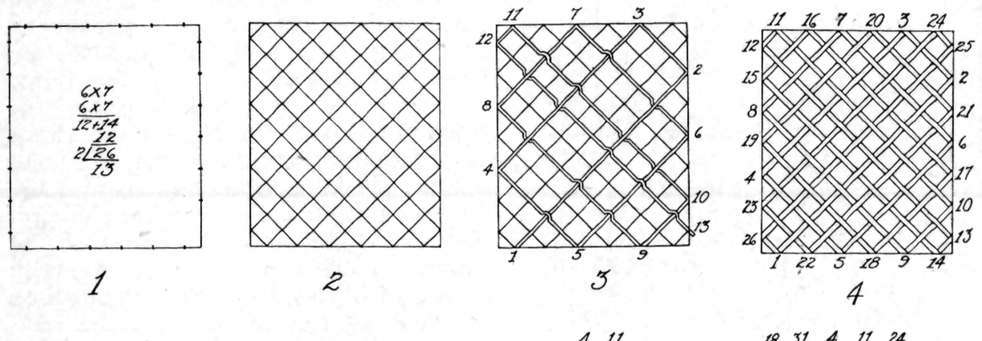
1. Locate point 1 as shown near the corner of the frame. Follow along the diagonal line to the side of the frame and mark point 2, see Sketch 3. Follow through from point to point along diagonal lines. This should return to point 1 when each diagonal has been traversed.

2. **Locate Points 3-4-5 by following diagonals** from point to point. Note the line from point 4 to 5 crosses line 1 to 2. It may be made to pass over or under as a matter of choice. We show it crossing over. Continue to point 6. The line between points 6 and 7 crosses lines 1-2 and 3-4.

3. **Determine the Thong Crossing Pattern.** Refer to the **first crossed line** at the point where line 1-2 is crossed by line 4-5. **Line 4-5 passes over line 1-2.** When the frame pattern is finished we find that seven diagonal lines cross line 1-2, paralleling line 4-5. Inspect each in turn. The first line above line 4-5 must pass under line 1-2—the next over line 1-2, and so on. This method shows line 6-7 to pass under line 1-2. By inspection we find that line 6-7 crosses over line 3-4. Continue this process until point 13 is reached. This is the halfway point beyond which the pattern need not be detailed, since the position of the cross over to make a "basket weave" becomes apparent during the frame lacing procedure.

Sketch 4 shows the appearance of a completed frame laced with a rawhide thong.

Fig. 1



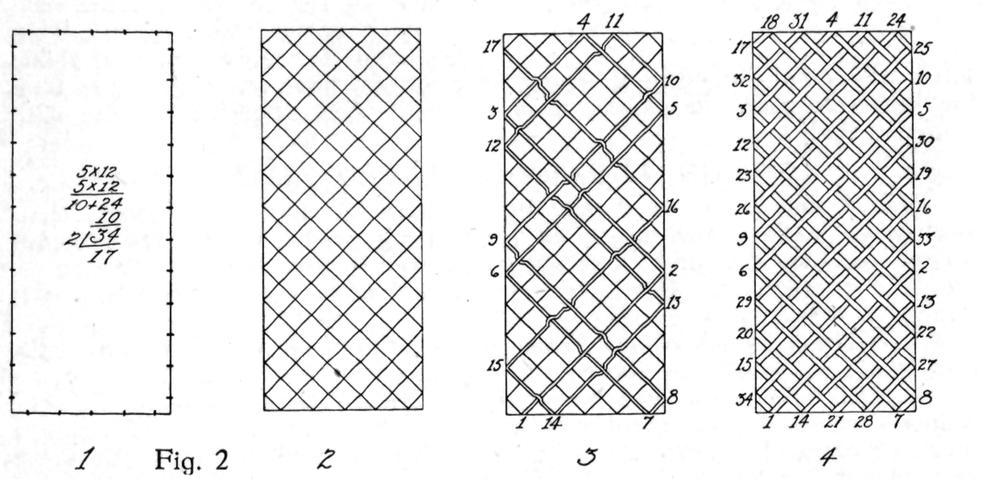


Fig. 2

The start at point 1 is made by tying the free end of the rawhide thong, which protrudes from the "tamale," to the chair frame. When point 2 is reached **carry the thong over the top, around the rail and over itself.** Repeat this procedure at each point and terminate the lacing by joining the thong at point 1, either with a knot tied with wet thongs or by a tack driven into the rail from the under side.

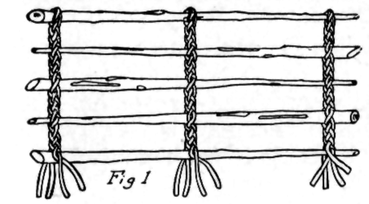
The procedure in lacing a rectangular shaped frame is indicated in Fig. 2. Sketches 1 to 4. The mesh size recommended for lacing the seats of chairs, benches, etc., should not exceed 2″x2″ in size. That for backs of chairs, seats, etc., may be made 3″x4″ in size.

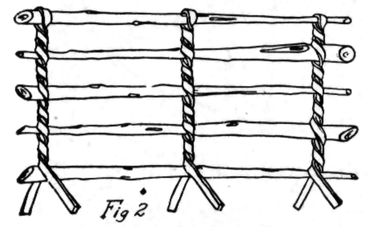
The required thong length may be approximated by measurements **diagonal lengths in pattern** to which must be added the length required to encircle the rail. A rough guide to follow in ascertaining quantity of rawhide thong is to allow 20 to 22 feet per square foot of surface to be laced.

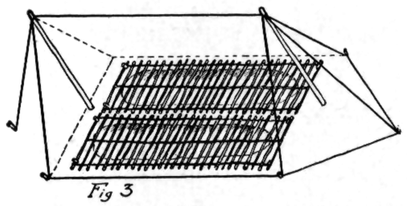
RAWHIDE HANDICRAFT
WILLOW CAMP BED

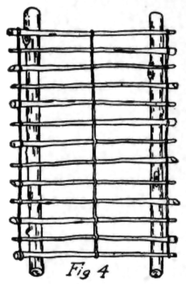
Select willow twigs that will yield pieces 28 to 30 inches long, which will be about ⅜ inch in diameter at the butt end and not less than ¼ inch in diameter at the other end after the bark is peeled.

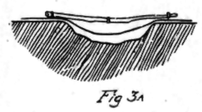
Array the peeled withes, alternating the butt ends shown in Fig. 1 and 2.

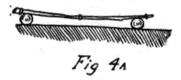












There are several methods of lashing the bed together with rawhide thongs. The simplest method perhaps is to twist a rawhide thong ¼ inch wide around the twigs as shown in Fig. 2. Plaited thongs are equally effective and the method of construction is indicated in Fig. 1. Thongs ⅛ inch wide are adequate for the purpose.

The spacing of the willow sticks may vary from the thickness of the rawhide to about one inch or slightly more. The rawhide should be kept soft and pliable by moistening from time to time.

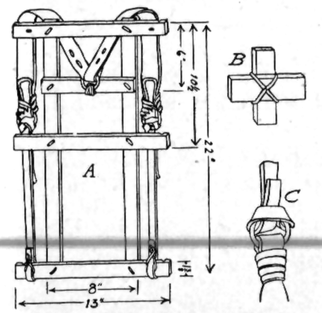
The bed may be made any length desired, and the thongs should be 2½ to three times the length of the bed. Short length thongs may be used and effectively spliced by tying a square knot.

Suggestions for the use of the willow bed are given in Fig. 3 and 4. In Fig. 3 the beds are placed on the ground in a pup tent. The ground has been hollowed out beneath the bed and covered with a ground cloth or poncha. The four corners of the frame are held by driving pegs in the ground at each corner. Where the ground is damp the bed may be placed on logs as indicated in Fig. 4 and 4a.

The Sioux Indians used willow foot and head boards to separate their beds in the tepees. The willows are placed closely side by side and the rawhide thong is passed thru holes drilled thru the twigs.

Back Pack Frame

The pack frame appearing in the photograph, page 151, also in the dimensioned sketch below is an excellent individual or group project. The materials are readily obtainable and inexpensive. Sketch A shows the assembly made with rawhide thongs which pass thru two holes drilled in each intersection.



Sketch B shows method of lashing for one hole drilled in the intersection. The shoulder straps are attached to the center of the pack frame, on the cross member as shown in the sketch A.

Sketch C shows a suitable type of adjustable fastener for securing the shoulder straps to the bottom of the frame. The details for this type of fastening are given on page 79.

The pack may be held in place by straps or rope. The three cross members are grooved near the ends to receive the rope. The pack

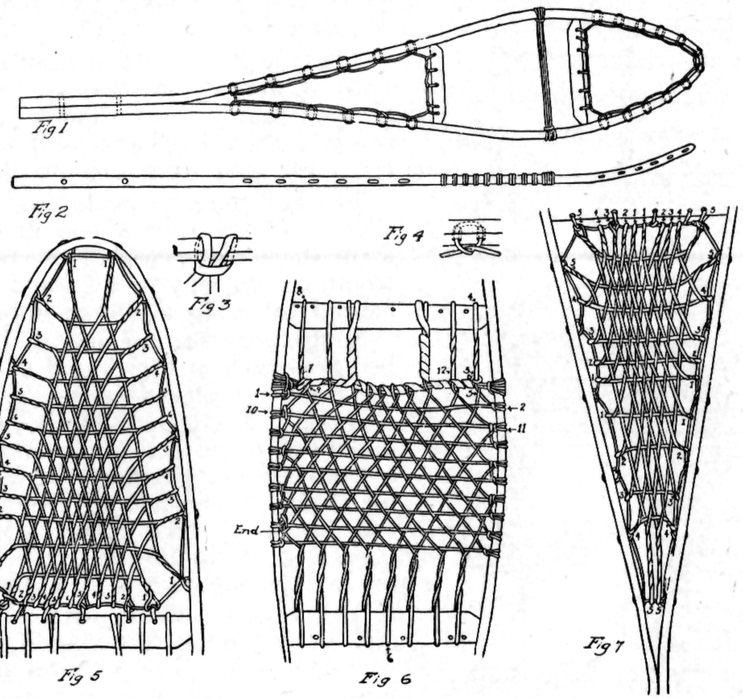
may be carried with or without the tump line shown in the photograph. Page 151.

We are indebted to Mr. H. A. Gatley, Scout Executive, Kenosha, Wisconsin, for the dimensions of this frame and the harness arrangement. A similar frame was used by him while in the U. S. Forest Service.

SNOW SHOES

The lacing of frames with rawhide thongs has been given on page 142 in detail.

In Figures 1 to 7, snowshoe frame lacing details are presented. Fig. 1 shows the complete frame with the toe, middle and heel panels threaded with a rawhide thong. Fig. 4 shows the method of threading the frame thru holes drilled in the wood.



The toe panel is laced with ⅛ inch rawhide thongs, and for convenience in following the pattern the points of each mesh have been numbered. Mesh No. 1 starts at the lower left hand corner and progresses to the next and each succeeding point numbered 1, and back to the original point. The thong is caried to point 2 then mesh 2 and back to the starting point, then to point 3 and so on.

The middle panel is laced with ¼ inch rawhide thongs, and the thong is carried around the frame as shown in Fig. 3. A continuous weave is used in lacing, starting at point 1, the lacing pattern is carried thru numbered points thru point 12. Beyond this point the method should be apparent. The lacing is ended at the lower left hand corner at the point marked end.

The heel panel is laced with ⅛ inch rawhide thong in a manner similar to the toe mesh. Each mesh is numbered for convenience in tracing the course as the weaving progresses.

The amount of rawhide thong required to lace a six foot snow shoe is as follows: Toe panel 8 yards ⅛ inch thong, middle panel 17 yards ¼ inch thong, heel panel 6 yards ⅛ inch thong.

After the thongs have become thoroughly dried they must be waterproofed with a good grade of weather proof varnish.

LARIAT MAKING

The Lariat is a project suitable for an activity of a group experienced in thong plaiting. The instructions outlined here are for making a strand of four plait round. The rawhide thongs should be approximately 1/3 longer than the desired length of the lariat, and the width of all four thongs should equal the circumference of the core (see sketch D, Fig. 2). The thongs are plaited over a core, which may be of rawhide or a woven cotton clothesline or sash cord. The woven cotton cord is preferable to the rawhide, since it is round, of uniform size, possesses great strength and is soft and pliable.

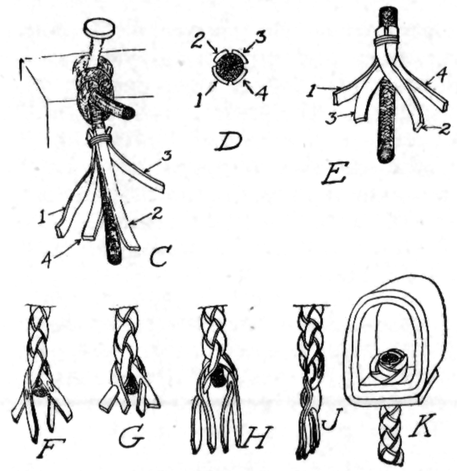


Fig. 2

Attach one end of the cord to a support (a 20 penny spike driven into a log, or timber not lighter than a 2x4) and lash the free ends of four rawhide thongs coiled as described above for making tamales, to the core near the support (see Fig. 2, sketch C). Cross thong 2 over 3 on top of the woven cord core (see sketch E, Fig. 2). Bring thong 1 around behind the core under thong 4 and cross it over thong 2. Keep the thongs moist by dipping the tamales in a bucket of water, and mo'sten the thongs as they are pulled out of the tamales by rubbing or stripping them with wet hands. Keep a uniform tension on the thongs as the plaiting progresses. When the desired length has been plaited, cut the core about 6 inches shorter than the ends of the rawhide thongs. Conceal the end of the core by plaiting the strand for another inch. Terminate with the Turk's Head knot or end the plaiting by splitting each thong and passing the ends through the slits as illustrated in Fig. 2, Sketches F, G, H, and J.

This method of ending will secure the thongs without increasing the diameter of the end of the lariat. Remove the plaited strand from the support and make the loop or honda, as it has been named by our Mexican neighbors.

Before making the honda, the plaited strand must be rolled and stretched. However more pressure is required to smooth out rawhide, which must be moist, than is required for rolling strands made of calf-skin. It can be rolled under foot, or better still, between two flat surfaces under pressure. Marble slabs are excellent for this purpose.

Several schemes have been employed for making hondas. Two will be described here. One method is to make an eye splice as in rope work, and then cover the loop with leather to make a neat looking job. This eye splice is easily enough made with the thongs, but it is rather difficult to conceal the ends of the core and taper it properly to avoid an unsightly thickness, which may detract from the general appearance of the work.

A much neater honda is made by rolling up a strip of rawhide ¾ inch wide into a coil having an inside diameter of about 2 inches. Three or four layers, depending on the thickness of the rawh'de, will give sufficient strength. A hole is punched or reamed through this coil of rawhide as illustrated in Fig. 2, Sketch K, just large enough to receive the plaited strand which is fed through the hole from the outside of the coil. Tie a terminal

Turk's Head knot enlarged as indicated on page 137, Fig. 26, N-O-P, around the core. After the thongs become dry, the core and ends of the thongs protruding from the end of the Turk's Head should be trimmed off close up to the knot. The plaited strand is pulled back through the coiled rawhide strap until the Turk's Head seats against the inside of the honda. This completes the making of the lariat which must be softened before it is ready for use.

The softening process consists of impregnating the thongs with animal oil or fat. Neatsfoot oil is best; however, beef and mutton tallow may be used. In case you are working with tallow, melt it, and after cooling to a lukewarm temperature, soak the plaited strand in the melted tallow until it has penetrated the thongs. During the process the vessel containing the tallow must be kept warm enough to maintain this temperature. Before placing the lariat in oil or fat it should be soaked in water until it becomes soft and pliable. All water that adheres to the lariat must be removed. Dry the coil with a cloth or in the air until water cannot be wrung from the thongs, which must still be moist, soft and pliable.

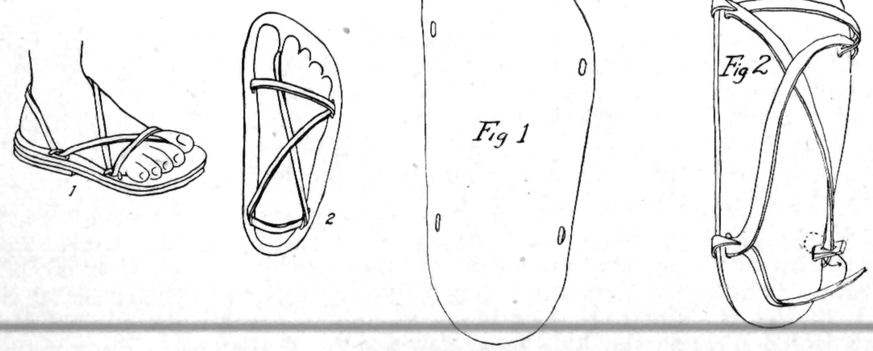
Remove the lariat from the tallow or oil bath and after the tallow hardens or the excess oil drains off, work the lariat over a log or post. This rubbing friction will make the lariat flexible. If it does not become as soft as desired with the oil or tallow treatment, repeat. This time, however, it is not necessary to soak the lariat in water before placing it in the oil.

The lariat may be polished by rubbing with old newspapers.

RAWHIDE SANDALS AND MOCCASIN SOLES

The Indian has long used the heavier pieces of skins, neck and back portions of rawhide, for the soles of his foot wear. The rawhide moccasin sole sinew sewed to a buckskin upper is a combination which has been used by the American Indians for centuries, and only when genuine buckskin is unobtainable is a substitution thought of by the present day Indians. The detail of sewing a moccasin sole and upper together is given on page 486 and 487.

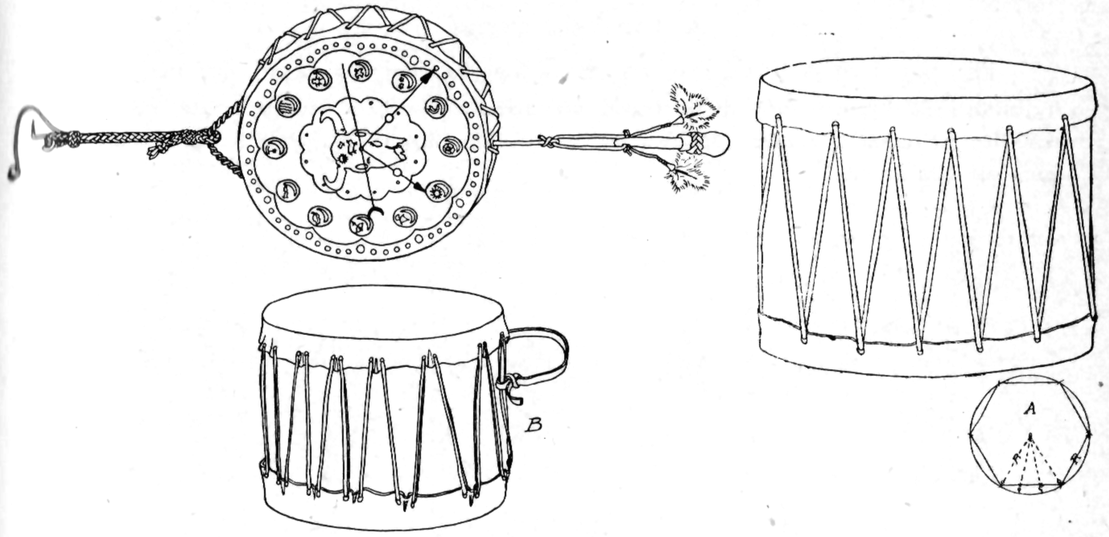
In Mexico among the Peons a sandal is sometimes worn which is similar to those illustrated below. A heavy rawhide sole is attached to the foot with a soft pliable wide thong. This type of sandal may be water-proofed by coating heavily with a good varnish or shellac.



TOM-TOMS

The original Tom-Tom or Indian Drum was made out of a hollow log, with a piece of rawhide stretched over each end, and secured by a rawhide thong laced between the drum heads. Many Indian tribes at the present time make their Tom-Toms by stretching pieces of rawhide over the ends of a cheese box from which the bottom has been removed. The accompanying sketch indicates the method of lacing the rawhide pieces together. Sketch A shows a method of spacing the holes about three inches apart and about one half to one inch from the edge of the head. Both rawhide pieces and thong must be moist and pliable when the Tom-Tom is assembled. The lacing holes are punched in both heads, and one is placed upon the table, flesh side up. The cheese box is placed on this and centered so that the margin is of uniform width. The upper rawhide head is placed on top of the cheese box so that the lacing holes are staggered, that is, they come midway between the holes in the lower. This gives a diagonal slope to the lacing thongs, instead of vertical parallel thongs and produces a better shaped area between the laced thongs for decoration.

The two hole method of tom-tom assembly is shown in Sketch B. Note the thong passes through both holes spaced about an inch apart before it is carried to the opposite end of the tom-tom. This method of lacing distributes the pressure on the rawhide head. The holes are less apt to tear out when the lacing shrinks. Also the edge of the rawhide head may be crimped and more uniformly distributed betweeen the lacing points.



The Electric Tom Tom Clock is assembled by stretching a wet rawhide disc (clarified) over one end of a hollow log. A four inch length of log ten to twelve inches in diameter and having a wall thickness of $\frac{3}{8}$" to $\frac{1}{2}$" makes a satisfactory size. An electric clock movement is attached to the dry rawhide disc with the screws that hold the clock unit together. The support for the hands passes through a hole in the disc. After appropriate decoration is applied to the face the hands are pressed in place. The twelve Indian Moon symbols have been used instead of numerals. Candelabra lamp receptacles (use flame tint lamps) may be attached to the inside of the log with wood screws.

A control switch may be operated by a leather thong which passes through a hole in the bottom of the log. The thong is shown attached to a tom tom beater. The clock is supported by a plaited leather strand, made of four steerhide thongs plaited over the electrical service cord as a core.

Tom Tom

After the thongs and heads become thoroughly dry the Tom-Tom is ready to be painted. Several design motifs suitable for Tom-Tom heads or shields are given in the accompanying sketches.

A Tom-Tom Beater

The Sketches A to G, Fig. 16, show the construction details for making a Tom-Tom Beater, which will not lose its head with ordinary use. The handle is usually made from a branch and should be about ¾ of an inch in diameter.

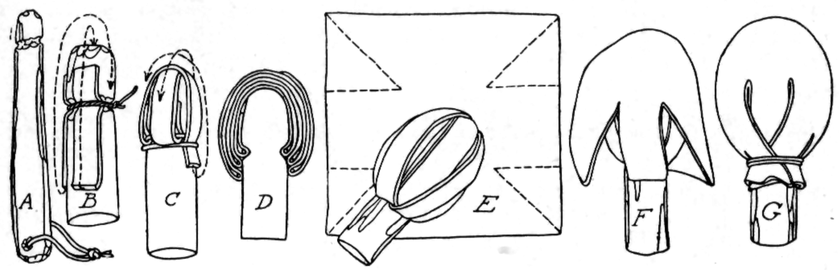


Fig. 16

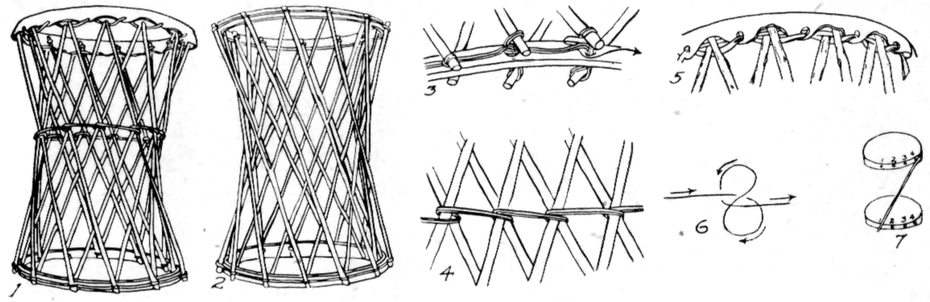
A groove is cut around the stick about an inch from the end, Sketch A. Three or four strips of leather, ½ by 8 inches, are placed along the handle with one end crossing the groove. These are tied securely with a piece of string or thong which pulls the strips into the groove. The loose ends are then carried back over the end of the beater and down the handle to a point just below the first string where they are again tied securely. Continue this process until the desired size of head is obtained. The outline of the piece to be cut for the cover from a square of leather is shown in sketch E. This is placed over the wrapped end of the beater and secured with string or a wet rawhide thong.

The Apache Stool

Another example of American Indian ingenuity expressed in his handcraft is the **Apache Stool.** This piece of craftwork shows the influence of the Spanish Padres who developed technics for utilizing native materials—rawhide, split poles, willows, pigskins, etc., in making primitive furnishings for the early missions. Yet the urge to make the stool, here described, came and found expression with the Indian's discovery of the wooden barrel hoop. This contribution of the white man was introduced to the Indians along the Mexican border by the early traders, much of whose merchandise was freighted into the trading posts packed in wooden barrels. The wooden barrel hoop was round, strong, light in weight and could be pierced without splitting whereas the hand whittled sapling had to be shaped while green, and frequently broke while being bent into shape. Splitting was unavoidable and occurred when the hoop, made of native materials was pierced to receive the rawhide thong. It was never round when shaped and required reinforcement with rawhide thong to hold the splinters together. So naturally the native craftsman welcomed a ready made hoop and enthusiastically appropriated to his use the ready made wooden barrel hoop.

This stool is a very serviceable, durable light weight piece of furniture. In a workshop, den or rustic nook it will be found useful as well as giving a touch of the primitive. Besides being ornamental, it is very comfortable and may be made in the desired diameter and height to suit any special purpose. It is especially recommended for use as a sewing machine stool, a seat for a writing desk, telephone table, drafting table or loom.

The materials consists of: two wooden barrel hoops, twenty-two peeled willow widths of the desired length ranging from 5/8″ to 3/8″ end diameters, a rawhide disc two inches larger than the hoop diameter and four rawhide thongs ¼″ to 3/8″ wide, each about the circumference of the hoop in length.



Assembly Procedure

1. Drill 11, 13, 15 or more as may be required holes ¼″ in diameter equally spaced in each hoop depending on the size of the hoop. The hole spacing should average about three inches apart.

2. Attach the willows to the hoop as indicated in Sketch 2. One row of willows is inside of the hoop and the other on the outside.

The seizing thong of rawhide is applied while it is wet (soft and pliable) as follows:

Carry the thong along on the outside of the hoop. Pass it through a hole and around the willow on the inside of the hoop, clockwise, as shown in Sketch 6.

Again pass the thong through the same hole and around the willow on the outside of the hoop, in a counter clockwise direction.

The thong makes a figure eight pattern, see Sketch 6, and passes under itself before it is carried to the next hole.

The height of the stool is predetermined and the length of the willow chosen to suit the diagonal slope. For example, willows 18" long, spaced between No. 1 hole at the bottom and No. 4 hole at the top, will make a stool 16½" high.

3. Lace the rawhide disc top, a piece of green rawhide either dehaired or with the "hair on" as desired, to the frame as indicated in Sketch 5.

Carry the rawhide lacing thong around the top. Loop it under each pair of willows, then through a hole in the disc. Thread the thong through from the outside, carry it under the two willows before passing it through the next hole in the disc. Repeat.

4. Secure the willows at the middle point with a rawhide thong lashing as shown in Sketch 4.

Permit the rawhide to dry before using the stool. If used in a moist climate, shellac or varnish all rawhide thongs.

CLUBS AND RATTLES

In those Indian Ceremonials which depict deeds of valor, and re-enact scenes of triumph over the enemy, war-clubs, tomahawks or "headache sticks" are an important equipment carried by the dancers. Rattles are primarily the instrument of the musicians, although sometimes carried by the dancers.

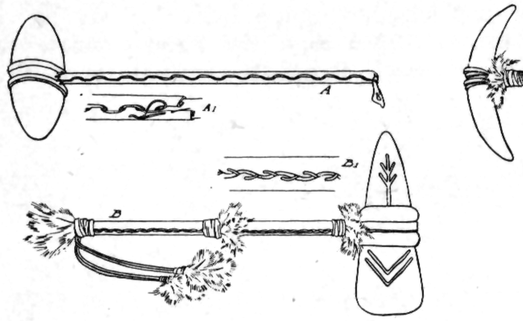


Fig. 1

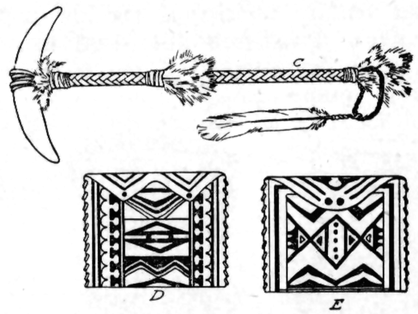


Fig. 2

Several types of Clubs and Rattles are illustrated in Figures 1 and 2 Sketches A and B—Fig. 1, show two styles of "Headache Sticks," both of which have stone heads attached to a wooden handle with strips of Rawhide which have been sinew sewed in place. Two styles of stitch are shown. In Sketch B-1 the raw edges of the Rawhide are brought together by an over and under the edge stitch. The holes are punched with an awl and the sinew is passed thru the awl holes. No needle is required. In sketch C is shown a Rattle made of the tips of two Cowhorns joined together and fastened to the handle by rawhide thongs which are plaited around the handle as a core.

The colored fluffy feathers have been added for decoration. A small pebble should be inserted in the horn cavity in case the club is to become a rattle.

The type of Rattle shown in Fig. 3, A and B, is made of Rawhide. The wet Rawhide of the shape shown in sketch A is sewed together at the edge with a simple whip stitch. A small opening is left at the bottom where the handle is attached. This opening should be large enough for the rawhide

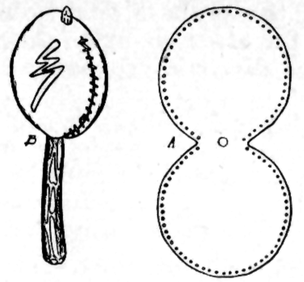
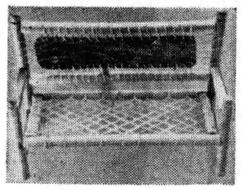


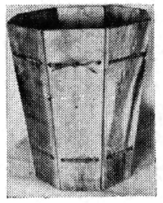
Fig. 3

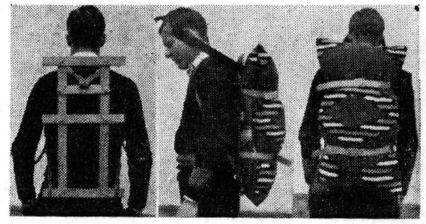
sack to be reversed. After it is turned inside out, the Rattle is filled with sand and stretched until smooth and moulded into shape. It is then put away to dry. Later the sand is shaken out and two or three small pebbles are inserted. The handle is attached by passing it thru the Rattle and thru a small hole at the top. The lower part of the Rattle around the opening is softened by wetting and when pliable it is sewed and seized to the handle. Frequently a small wooden pin is inserted through the handle above and below the rawhide to prevent the rawhide slipping off the handle. After the Rawhide has become thoroughly dry it may be decorated with oil paint and later shellac coated or varnished to make it moisture proof.

PARFLECHE BAGS

The Indian pouches or bags used for carrying tools and materials, also jerked meats, dried berries or what not, were made of thin dehaired Rawhide. These bags were either sinew sewed or edge laced with rawhide thongs and the flap held in place by buckskin thongs. The surface decorations were made highly ornate by painting the design in bright colors. The illustration, Fig. 2, D and E, show two Parfleche Bags of the same style. Two types of flaps are shown. A buckskin thong attached to the front of the bags passes thru the hole in the flap directly above and the ends are tied together.







Several projects making use of Rawhide are presented in the photograph. Rustic furniture laced with rawhide thongs waste paper basket made from boxwood and held together by a rawhide thong. A back pack frame laced together with heavy rawhide.

PREPARATION OF RAWHIDE

Obtain a small calf hide from the local butcher, slaughter house or neighbor farmer, preferably a green hide (that is one that has not become dry since removal from the carcass). Stretch the skin, either in a frame or tack it to the floor or side of a building, scrape off all flesh and rub salt into the flesh side of the skin. Permit the hide to remain stretched until it becomes nearly dry. The drying operation will require frequent inspection. The change which takes place in rawhide, namely from a condition of pliability to one of rigidity occurs in a period of an hour or two. The thongs must be cut while the hide is pliable. As soon as the hide has dried sufficiently to hold its shape, trim off the shanks (leg portion), the thicker neck

portions, also the thinner flank portions, and fashion a large disc of circular or oblong shape out of the trimmed hide. Inspect the edges of the hide to see that the portion of the hide remaining is approximately the same thickness.

Cut the discs into a thong by the knife and board method. Place the hide on the floor or on a table top, hair side uppermost. Nail a notched gauge to a board and stick a knife blade into the board with the leader in a position for a thong to be cut. The assistance of a helper will greatly facilitate rotation of the rawhide discs during the thong cutting operation.

The cut rawhide thong with the "hair on" is ready for use. In many projects the presence of the hair on the thong is not objectionable, but rather adds a primitive touch to the work. After the thong has been applied, and is set to shape, but before the thong has become thoroughly dry, the hair may be scraped off the exposed surfaces where desired.

In case the thong is not to be used immediately, it may be kept soft and pliable by soaking in a bucket of water for a few hours. It is not advisable to keep thongs in a water or salt solution much longer than overnight, for decomposition occurs slowly, which will cause the hair to slip and the thongs to become spongy. A rawhide thong that has dried in the air will become hard, and may be preserved indefinitely. When needed it may be soaked in water and again become pliable and ready for use.

TANNING METHODS
SUITABLE FOR CAMP USE

Skins suitable for camp projects in tanning are preferably from small animals. Rabbits, Guinea Pigs, Dogs, Cats, Sheep, Colts, are among the domestic animals, and Squirrel, Rabbit, Ground Hog, Woodchuck, Skunk, Muskrat, Prairie Dog, Badger, Fox, Deer, from the wild animals.

The sources of supply for skins of domestic animals are the slaughter house or butcher, the animal pound, and occasionally the members of the medical profession can furnish skins of Guinea Pigs. Skins of wild animals are available through dealers in pelts and furs. Frequently farmers who trap and others who shoot game during the hunting season can supply Camp Directors with a skin for use in demonstrating the methods of tanning in a Boys' Camp.

Equipment: The size of the skin determines the size of the container, and the quantity of tanning solution required. This activity may be tested out with a minimum of equipment, usually consisting of water tight wooden containers as may be available, such as wooden buckets, wash tubs, discarded butter and lard firkins, or the halves of vinegar barrels. Each container should have a cover—boards secured by cleats make satisfactory covers. (Later on, as the activity becomes established, wooden or concrete vats may be constructed, which are better suited to the tanning process.)

The other equipment required may be made up from rustic materials commonly found in camps and will be described later.

Methods: The methods of tanning described here are those used by many hunters and trappers who have used them with the minimum of equipment available in the out-of-doors or constructed out of rustic materials.

The accepted meaning of the word tanning is that of preserving skins in a way to stop decomposition, strengthen and toughen the skin, make it pliable and usually waterproof. Yet in a more technical sense there are three processes of preserving skins.

Tanning: This process consists of treatment with tannic acid, as contained in tan-bark, oak, hemlock or other vegetable compounds.

Tawing: This process consists of treatment with alum, bichromate of potash, or other salts.

Chamoising: This is the process of treating and filling with oil.

The methods of tanning described here are those used by the Indian, Pioneer and Frontiersman, who depended upon his skill as a trapper and hunter for that portion of his clothing and shelter which could be made from the skins of animals. In fact, the methods outlined here are those used by the writer's friend, Mr. C. L. "Grizzly" Smith, author and lecturer, who spent many years of his life as a hunter, trapper and guide in our own and the Canadian Northwest.

Buckskin Tan: The methods of producing a buckskin tan are applicable to the skin of any small animal.

1. Dehairing. The process of removing the hair is preliminary to any of the following methods of tanning.

Fresh skins may be dehaired without soaking in a solution for loosening the hair, which will slip and come off with scraping.

Dry skins require soaking in a solution of wood ash and water of a batter consistency or a milk of lime solution, prepared by dissolving ten pounds of quick lime (unslaked lime) in about three gallons of water. The skin should be left in either solution only long enough for the hair to loosen so that it will slip off the skin when pulled or scraped. The time of soaking will vary with the strength of the solution, and can be determined by testing. Usually the time will vary from three to twelve hours.

As soon as the hair will slip, the skin should be spread out over a smooth bark peeled log, preferably 10 or 12 inches in diameter. The scraping may be done with the edge of a beef rib bone, or the edge of an old case knife. An effective scraper may be made out of a case knife and a block of wood into which the blade of a knife has been driven or set into a saw cut. The block ends may be tapered and rounded to form a handle. See Fig. 3, Sketches E, F, and G.

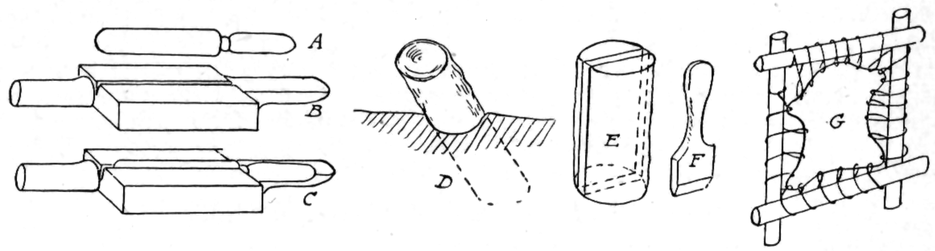


Fig. 4

The scraping is done with the back of the case knife and the hair is actually shoved or pushed off the skin. One person may hold the skin while another person does the scraping, unless a stripping post is used. The dehairing operation may be accomplished by one person with the following equipment. See Fig. 4, Sketch B.

A stripping post may be made out of a log as shown in Fig. 4, Sketch D. The stripping post is used by draping the skin over the top, hair side up, and the hair is slipped off with the scraper by a downward thrust. The skin is held firmly in place by the person leaning against the overhanging end of the skin. An apron should be worn to protect the clothing during this process.

It will be noticed that after the hair is removed, a thin skin covers the dehaired hide. This is known as the scarf skin, and may or may not be removed, depending on the quality of the buckskin desired. If the scarf

skin is left on, the result is known as grain buckskin, which is usually stiffer and has the appearance of a thin, transparent coating over the surface of the skin. Grain buckskin sheds water readily and is suitable for garments that may be worn in the rain. A sizing described on page 156 must be used for grain buckskin.

If the scarf skin is removed, the finished buckskin has a soft, fluffy appearance and it requires close inspection to determine which is the flesh or the grain side of the leather.

There are several methods of treating the ungrained buckskin, that may be employed from this point, to make the skin soft and pliable. Each of these will be described later, also the smoking process which must be given if the skin is to retain the soft and pliable quality after wetting.

Brain Tan—or old Indian Method of Making Buckskin.

The brain of any animal may be used in the preparation of a solution for softening the skin. A solution is made from either fresh or dry brain by mashing or pulverizing the brain tissue and dissolving this in a small quantity of lukewarm water. Strain the liquid through a cloth to remove any undissolved tissue, and add more water to the solution, which will resemble a soap solution and will form a suds. Rinse out all trace of wood ash or lime from the dehaired skin in clear water before placing it in the brain solution, which should be of sufficient depth to cover the skin. Wash the skin thoroughly in the solution and permit it to soak over night. Remove the skin and stretch it in a drying frame, which may be placed in bright sunshine or near a fire. The skin must now be worked or flexed with a rubbing stick applied to both sides of the hide, until dry. Afterwards remove the skin from the frame and it is ready to be smoked as is described on page 156. The rubbing stick may be made out of a plank, or by hewing a slab out of a 4 or 5 inch log about 3 feet long, and giving it the shape of a canoe paddle with a very short blade. See Fig. 4, Sketches E and F.

The frame mentioned is made of materials at hand, boards or rustic materials, which are nailed or lashed together. The space inside the frame should permit the skin to be stretched freely without overhanging the frame (see Fig. 4, Sketch G). The skin is stretched by lacing it to the frame with heavy cord. The rubbing operation consists of pressing the rubbing stick against the surface of the skin and moving it back and forth across the skin from top to bottom and side to side, working first one side of the skin and then the other.

"Out in Camp" Method of Making Buckskin

Dehair and grain the hide green, that is, as soon as possible after it has been taken from the animal. In case the hide has been dried, it must be soaked in water until soft. Then remove the hair by scraping. Should the hair not slip readily, it may be treated with wood ash. In the absence of a container, scrape out a bowl shaped depression in the ground and place the hide in it, flesh side down. Smooth out any wrinkles in the hide and sprinkle fine wood ash over the hair surface for a depth of about two inches. Add water and stir until the wood ash mixture is of a batter-like consistency. Fold the outside edges of the hide in toward the center in order to bring all hair surfaces in contact with the wood ashes. The hide should be covered with a layer of dirt in order to prevent the upper portion of the hide from drying out.

Uncover a part of the hide in about 12 hours and test to see if the hair will slip. The ashes of hard wood are best, and the time required for the hair to loosen will depend on the strength of the solution. After removing the hair by scraping the hide, rinse in clear running water. Wring

out as much water as possible, and cover the grain side of the hide with bacon grease. Spread the hide out in the open until almost dry, then place in a container or the depression as before, and pour in a strong solution of soap and water. Wash the hide thoroughly. Stretch in a frame and work until dry with a rubbing stick as previously described. Repeat the oiling and washing process if the skin is not soft enough. It should then be smoked, which process is described below.

The sequence of operation in making ungrained buckskin is practically the same as the method of procedure outlined, and the processes mentioned differ only in the solutions used. The following solutions have been tested and are recommended.

Salt and Alum Process: Make a saturated solution of one part alum and two parts salt dissolved in water. Soak the hide in the solution about three days. Stretch in frame until almost dry, then work until dry with the rubbing stick. Rub in Neatsfoot oil. Scrape the flesh side of the skin with a piece of pumice stone or other abrasive to fluff up the surface. Smoke the dry, soft skin to keep it soft after wetting.

Soap Suds and Kerosene Oil Process: Make a solution of laundry soap and warm water, using about one bar of soap to a gallon of water. After the soap is dissolved add kerosene oil until the soap solution will not combine with more oil.

Soak the hide in the solution about three days, stretch in a frame until almost dry, work with a rubbing stick until dry, then rub in Neatsfoot oil. Scrape the flesh side of the skin with a piece of pumice stone or other abrasive to fluff up the surface.

Smoke the skin so that it will retain its pliability after becoming wet.

Oxalic Acid Tan: Make a solution of oxalic acid and water in the proportion of three ounces of oxalic acid to each gallon of water.

Soak the hide in the solution about three or four days. Stretch the hide in a frame until nearly dry. Work soft with the rubbing stick until dry. Rub in Neatsfoot oil. Smoke.

Sulphuric Acid Tan: Make a solution of sulphuric acid and water in the proportion of one pound C. P. sulphuric acid to three gallons of water. Soak the hide in the solution about three hours. Hang it up to dry then crinkle in the hands. This method is recommended for fur tanning.

A Method of Smoking Buckskin: Buckskin tanned by any of the methods given will require the smoke treatment to keep it soft and pliable after it becomes wet. The skin must be exposed to a dense smoke without subjecting it to heat, which will cause brittleness and injure the skin.

Dig an oblong hole in the ground and form several arches of willow or other slender green twigs by forcing both ends of each twig into the ground so that the twig will arch over the trench like a croquet wicket. Place several wickets side by side across the hole and one or two lengthwise.

Place a few shovelsful of red hot coals into the hole and cover them up completely with a layer of dry rotten punk. As soon as the smoke smudge ascends in a cloud, lay the skin over the wicket for a few moments, then turn the skin and place it upon the wicket. When a uniform amber color is obtained on both sides of the skin the smoking operation is complete.

A Method of Making Grain Buckskin: Dehair the hide by either of the processes described on page 154, being careful not to injure the tender scarf skin which is easily torn by the scraper.

TANNING METHODS

The hide, if formerly dry has swelled or increased in thickness during the soaking operation preliminary to the dehairing process. Green hides are also thicker than dry ones.

The process of reducing this swelling and restoring the hide to its normal thickness is known as sizing the hide.

The sizing process requires soaking the hide in a sour pack. A good pack is made from wheat bran mash (that is, bran and water) to which yeast has been added, and permitted to ferment. The hide is packed well into the mash where it remains from three or four days to a week, during which time it will be reduced to its normal thickness.

This completes the sizing operation, after which the tanning may be completed by any process previously described.

Notes on Preservation of Heads, Skins and Scalps

In the interest of conservation, a few suggestions are given for the preservation of skins and scalps in the woods. It is not with the idea of giving instruction in the art of taxidermy, but to provide those persons who may have the opportunity to obtain a specimen of bird or animal life, with the necessary information to preserve a specimen until it may be prepared for mounting.

Annually, during the hunting season, when our game laws permit hunters to kill a stipulated minimum of our wild life, many beautiful specimens are lost through lack of knowledge of preservation, or due to the sportsman's failure to take the few necessary steps to insure preservation of his game.

It is to be deplored that the scarcity of our wild life may be traced to hunters who have killed for the mere barbaric fun of killing. Although this crime is decreasing through the operation of our game laws, there is needless loss and waste of wild life during the hunting season by hunters ignorant of the few principles of specimen preservation.

Numerous curators of both private and public collections would be willing to defray the taxidermist's or tanning charge for mounting many specimens of wild life, now lost through the hunter's carelessness.

Heads or Scalp to be Mounted

Make an incision in the back of the neck, splitting the skin up to a point on top of the head midway between the horns or ears. Cut across from horn to horn or from ear to ear and proceed to remove the skin from the head of the animal. Skin around the ears and eyes, cutting deeply to avoid cutting the eyelids.

Turn the skin wrong side out and remove the flesh from the skin and lips, being careful to skin and remove the cartilage from the ears.

Make a saturated solution of: (a) Salt (2 parts), alum (1 part); and water; or (b) Corrosive Sublimate (Mercury Sulphate).

Dissolve Mercury Sulphate crystals in water, which must be boiling. Paint all flesh surfaces of the skin with a brush or cloth dipped in the solution. Hang the skin up to dry.

Every Deerhide Should Be Saved

Commercial "chrome tan" yields a washable buckskin. The commercial process of "leveling a skin," that is reducing it to a uniform thickness, makes it suitable for gloves, vests, jackets, etc. The cost of machine leveling and chrome tanning a buckskin is lower than the average cost for any process by hand methods. An average size deerhide will yield five or six pairs of gloves, depending on style. A large skin will yield a vest. Three average size skins are required for a jacket.

METAL WORK

Pewter

The origin of pewter is lost in antiquity and we can only imagine the circumstances under which an ancient artisan discovered the method of combining lead and tin to form the alloy from which some of the earliest utensils were made. The use of pewter in China 3000 years ago is recorded and specimens of Japanese pewter ware are on exhibition in England which are known to be 1100 years old. Tin, the major element in pewter is mentioned in the Bible and the Egyptians used it as early as 3000 B. C.

In the time of Julius Caesar household utensils of pewter were in demand by the Romans, and they secured the metals, tin and lead, from the Cornwall mines in Britain which was known as "the classic land of lead and tin." It is also stated by historians that "these products brought the Phoenician trade, and had much to do with the Roman occupation of this distant land."

The art of working pewter was perfected during the Middle Ages. The craft guilds of the pewterers were highly organized in England and throughout Continental Europe in the 14th Century, and the history of this famous group of craftsmen is fascinating reading. Strict ethical codes prevailed in the organization which had authority from the king to establish proper alloys, set standards of quality and to certify the skill of workmen and their apprentices. They controlled production by limiting the manufacture of articles to those skilled in the art. Craftsmen were classified on the basis of their ability. Master pewters could make any kind of ware. Others were classified as "sad ware men" which alluded to the kind of metal used for plates, chargers or other flat ware, and "hollow ware men" who made pots and vessels for liquids. The lowest recognized grade was designated as "triflers" and their work was limited to the manufacture of spoons, salt cellars and other "trifles." The highest standards of workmanship were maintained in each group and heavy fines were imposed for bad craftsmanship. Inferior products could be confiscated and membership in the guild revoked for violations of the code. So closely guarded were the secret processes of the Pewterers that it was sometimes called "The Craft or Mystery." The well known political and industrial power of the Guild has passed into history, but its traditions and ideals survive, and must be cherished by the modern craftsman who seeks to develop skill in the art of working pewter.

Modern pewter ware is made from Britannia Metal which was developed during the middle of the 18th Century. It is an *alloy containing about 91 parts tin, 7.5 parts antimony and 1.5 parts copper, and since it contains no lead may safely be used as a container of food having an acid content. It is malleable without annealing and may be readily hammered into the desired shape, by means of tools and methods similar to those employed by the medieval pewterer, who termed this procedure "beating down."

Pewter possesses a charm peculiarly its own. A something about the luster and texture of its satiny grey surface gives tactile satisfaction not found in any other metal, and its soft neutral coloring harmonizes with almost any decoration.

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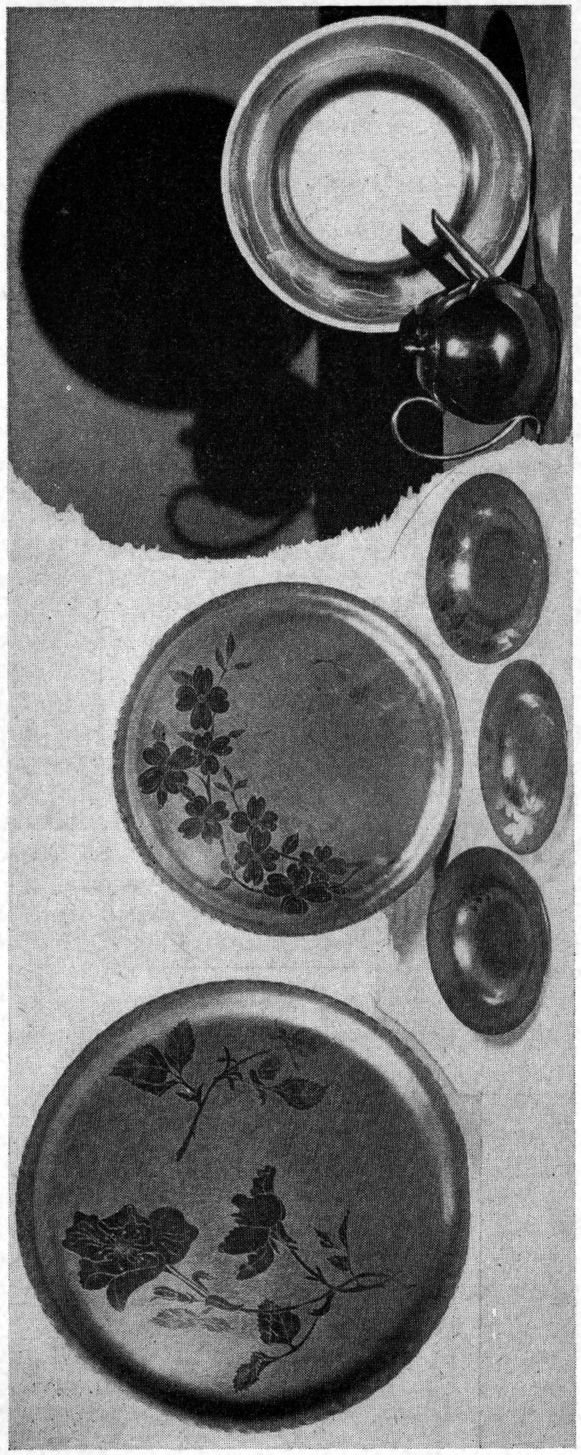
*No. 1, Hoyt's Pewter—see footnote, page 170.



The pewter pieces shown in the photographs were hand made by craftsmen of the Smoky Mountains near Penland, North Carolina. They were selected to show the effectiveness of simplicity of plain, hammered, pierced and etched decoration, applied to a variety of shapes. The construction of these raised shapes; in contour blocks, on a sand bag, or over a stake, also their assembly by soldering, indicate the mastery of skills in the art of working pewter developed by the Penland craftsmen.

Concerning Penland

It is a hopeful sign when craftwork of this quality is produced by a group of American People in a remote community, from material not indigenous to their region. Futhermore it is an index to the potentialities of life enrichment which derives from the learning experiences inherent in Handicraft. In Penland handicraft is a leisure time pursuit on a group work basis.

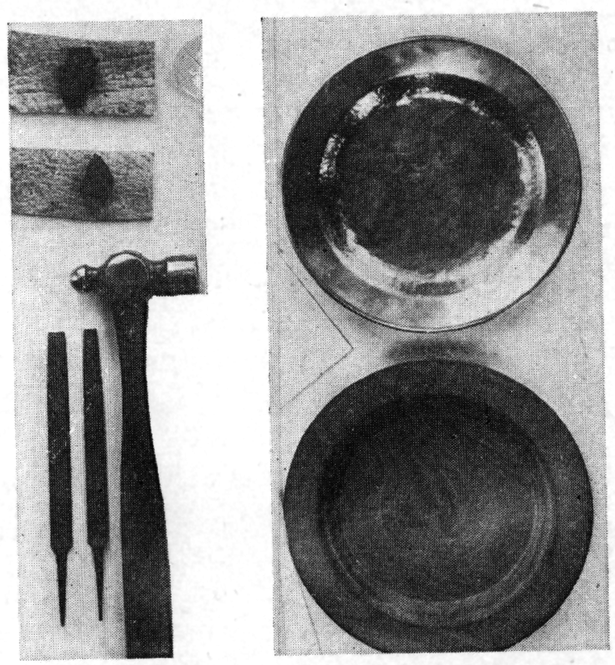
This work was started by Miss Lucy Morgan with instruction in pottery and weaving, designed to revive and re-establish on a commercial basis the native skills in these crafts, practiced for generations by the hill folk of the South. Metal work instruction was added to meet the desire for other skills and to provide a supplementary means of livelihood to the community, which is now noted for the excellence of all its handicraft products.

Appreciation for this service is attested by the sustained interest of the people of the community who are joined by able craftsmen from all parts of the United States, who came to share their skills and acquire others during summer vacations in the Smoky Mountains. Many of these craftsmen are teachers who contribute inspiration as well as skill improvement in the Penland community craft program. Through this interchange the outlook, energy and aspiration of all participants is enlarged to form a technique of better living. At Penland the American way is lived.

We are indebted to Miss Lucy Morgan, Director of the Penland School of Handicrafts, Penland, N. C., for the privilege of presenting the work of her neighbors. It illustrates not only a product of manual skills but an outstanding example of creative group work.

The following Projects have been selected to illustrate the elements and principles in Pewter Craftwork. When these are mastered a working knowledge of the possibilities and limitations of this metal will have been acquired. All of the articles shown may be constructed with the minimum of equipment.

Pewter Working Tools



PROJECT NO. 1—MESS KIT PLATE

Tools: Ball Pein Hammer. Files for rough cutting and smoothing. An 8″ Wooden Contour Block, Abrasives. Scratch Remover, Polish, Pencil Compass or pair of Dividers and Metal Shears, 7″.

Material: A Disc of 18 Gauge Pewter, which may be obtained in the specified size, or a piece of sheet pewter of the same gauge, large enough to yield a disc of the desired diameter.

Instruction:

1. Cutting the Plate Disc. Scribe a circle, 8⅝″ diameter, on the metal and cut the plate disc with the metal shears, following the outside of the marked line. This will leave sufficient metal to permit trueing up any edge irregularities with the rough file. The edges may then be dressed with the smoothing file.

2. Reinforcing the Edge of the Plate. Place the wooden contour block upon the table or work bench with the bottom or smooth side uppermost,

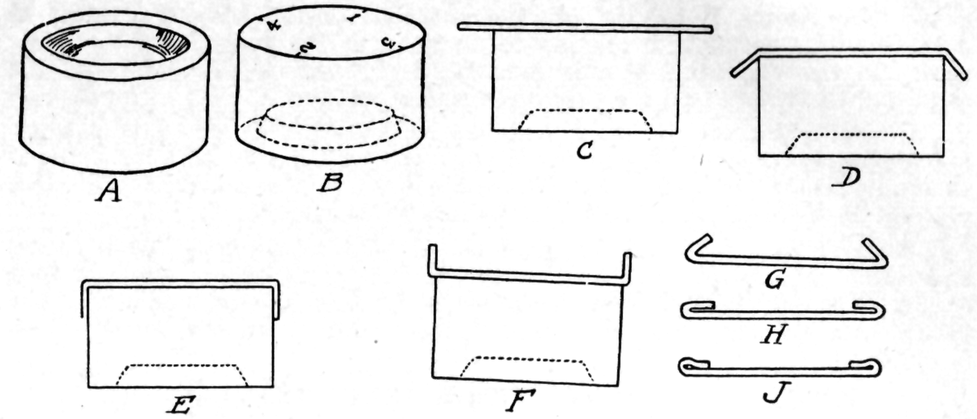


Fig. 1

Fig. 1, Sketch B. Position the disc on the block so that the edge projects equally at all points, 1, 2, 3 and 4. Bend the edge downward at these points with a light hammer blow as indicated in Sketch D. This centers the disc and the remaining edge is bent downward in the same manner. Continue the bending process until the edge is in contact with the block as shown in Sketch E.

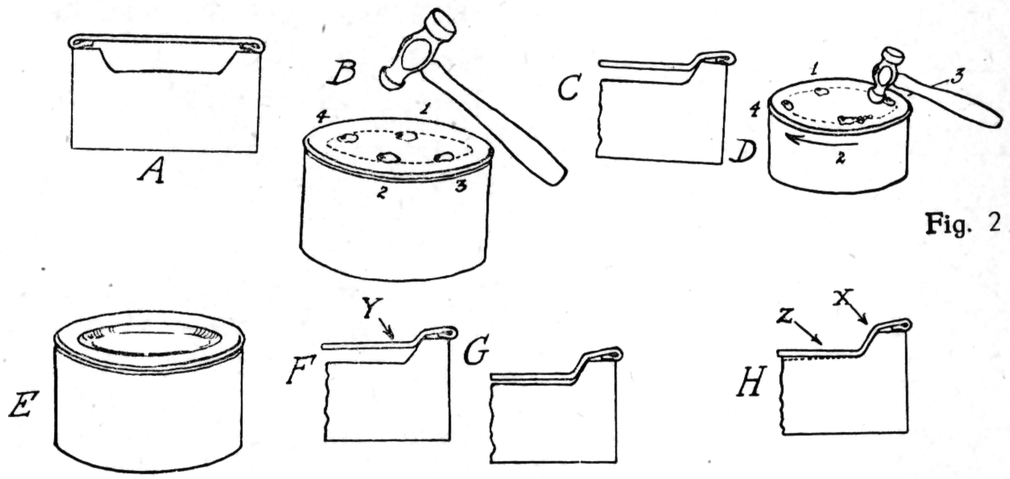


Fig. 2

Remove the disc from the block and reverse its position as shown in Sketch F. Continue bending the upturned edge inward as indicated in Sketch G. Then lap it back to the position shown by Sketch H, and finally hammer the inner edge down until it makes contact with the disc.

3. Forming the Plate. Reverse the contour block so that the plate cavity is uppermost. Place the disc on the block as indicated in Fig. 2, Sketch A, with the lapped edge on the lower side. Hold the disc firmly in contact with the block and with the ball end of the hammer make depressions at points 1, 2, 3 and 4, being careful meanwhile to keep the plate in the center of the block. Continue to strike the surface light tapping blows along the upper edge of the cavity as indicated at the point X, Sketch C. Rotate the plate to the left and connect the point 3, 1 and 4 with a row of depressions, Sketch E. Repeat this beating down process by moving in toward the center of the disc for the next and succeeding rows of depres-

sions. See Sketch F for the relative positions of the hammer contact at point Y. The metal is beginning to conform to the contour of the plate cavity in the Wooden block as indicated by Sketch G. In Sketch H the metal fits the cavity and the disc has become a plate.

Carefully inspect the work and hammer out the contour irregularities, making close contact between the plate and block cavity at all points. If carefully done this will partially smooth the surface and make it more uniform in texture. The process is known as planishing.

4. Polishing. Rub the scratch remover well into a piece of buckskin and apply the charged buckskin to the hammered surface. Wipe off with a soft cloth any scratch remover adhering to the surface, and apply the polish with another piece of buckskin. Rub gently until the desired finish is obtained.

PROJECT NO. 2—INDIVIDUAL SALT CONTAINER

Tools: Same as listed under Projects 1 and 3 with contour block having 2″ cavity.

Material: No. 18 Gauge Sheet Pewter for the container. Castings for the supports or 12 gauge metal from which they may be cut with the jeweler's saw.

Instruction:

1. Cut a disc 2½″ in diameter with the metal shears and true up the edges by filing.

2. Place the disc on the contour block, see Fig. 4, Sketch A. Keep

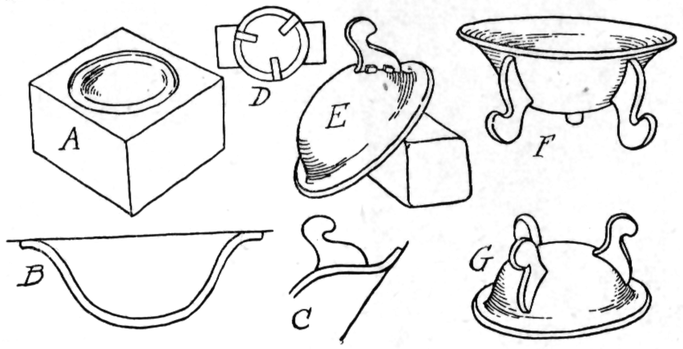


Fig. 4

the disc centered within the guide circle, while beating it down into contact with the sides of the cavity. The disc should resemble the bowl shape shown in Sketch B when removed from the contour block.

3. Attach the three supports by soldering as described on page 167. See Sketches D and E.

4. True up edge with smoothing file.

5. Polish, following instructions given under Project No. 1.

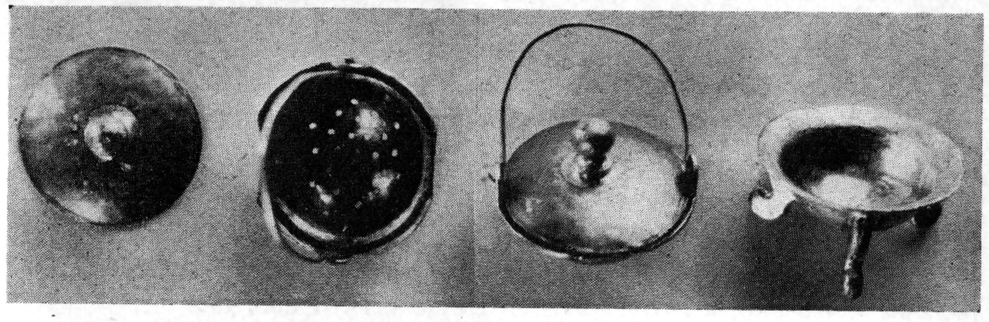
PROJECT NO. 3—TEA BALL

Tools: Same as listed under projects 1 and 3, with contour block having 2″ cavity, also a scraper or drill to perforate the bowl, a forming tool and a pair of pliers.

Materials: No. 18 gauge sheet metal, disc 2½″ diameter. Cast knob for cover and nickle silver ware for the handle.

Instruction:

1. Trace the design outline on paper. Cement the paper to the sheet metal as indicated in Fig. 5, Sketches A and B, page 163.



2. Cut the metal with a jeweler's saw on the design outline.

3. Shape the disc, Sketch B, by hammering it into contour block C. This piece becomes the cover for the Tea Ball. The knob, Sketch D is later soldered to the cover as indicated in Sketch E and the edge is filed to fit the rim of the ball as shown in Sketch F.

4. Shape the metal, Sketch A in the contour block F until it has the contour of the bowl indicated in Sketch G.

5. Form a rim around the upper edge of the bowl by forcing the metal into the grooved recess in the top of the contour block, see Sketches F and H. This is done with a forming tool and hammer.

6. Remove bowl from contour block and pierce it with a triangular metal scraper as shown in Sketch K. The piercing is done by rotating the tool while exerting sufficient pressure upon it to cut through the metal. Avoid excessive pressure which will result in a larger hole than is wanted. A burr or ring of rough edged metal will be left on the other side of the metal. Remove it by inserting the scraper from this side and twisting it as before, see Sketch K. A suggested pattern for piercing the bowl is shown in Sketch L.

7. Pierce the projecting ears to receive the wire handle as indicated in Sketches J and M. Bend with the pliers into a vertical position as shown in Sketch M.

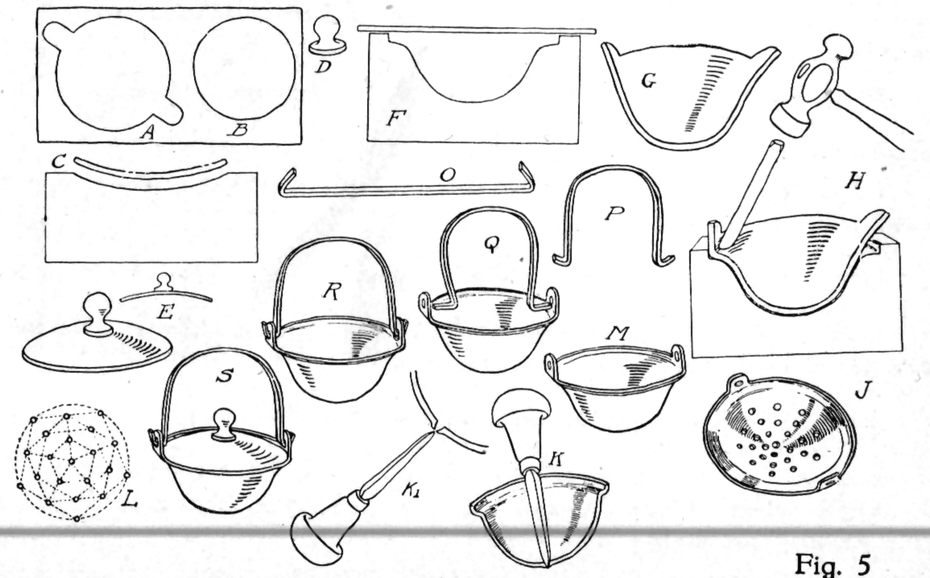


Fig. 5

8. Form the wire, Sketch O, into the shape in Sketch P. Spring it, as in Sketch Q and insert the ends in the holes pierced in the ears of the bowl. Sketch R shows one side of the tea ball with the handle attached. The end of the wire is bent upward to prevent it from slipping out of the ear.

9. Fitting the cover. File the edges of the cover so that it will slip into the recessed groove in the lower part of the ball. Also file the upper edge of the tea ball which protrudes above the cover. See the relative position of tea ball and cover indicated by Fig. 5, Sketch E-S.

10. Finish the edges and polish according to the instruction given under Projects 1, page 160.

The tea ball is made in the same contour block as the bowl of the salt container, Project 2. The tea ball will therefore fit into the bowl of the container so that a similar base may be made for a stand or drip cup.

Various uses for similar shapes cut in different sizes will suggest themselves. A perforated bowl and stand of the type described above could be made large enough for a table fern dish. Small individual nut or candy dishes about the same dimensions as the container would be attractive, and might be used with a larger serving dish to match.

PEWTER

PROJECT NO. 4—SPOON (Reinforced Handle and Overlay Initial)

Tools: Contour Block, Ball Pein Hammer, Wooden Mallet, Jeweler's Saw, Metal Shears. Files: half round, flat, single cut. Solder (70-30 Tin-Lead), Iron Binding Wire. Abrasives: No. 000 Steel Wool, Emery Cloth and Oil, Powdered Pumice.

Materials: Sheet of Hoyt's Pewter, No. 3 Britannia. 16 gauge.

Instruction:

1. Scribe the outlines of parts A and B on the sheet pewter, also the initial letter or other ornament.

Cut to line with jeweler's saw and shears.

2. Remove the rough edges with file and restore the flatness of the metal with wood mallet on a smooth surfaced block.

3. Solder reinforcement to spoon blank, Sketches C, D, E.

a. Apply flux to upper surface of part B, also on the under surface of the spoon blank. Place the two together in position shown in Sketch D. Wrap with iron binding wire.

b. Place snippets of 70-30 solder along the edges ab-cd and apply the heat from underneath to melt the solder. Sketches D, E, F.

c. Turn the spoon blank over. Apply flux and snippets of solder along the edges, aec-bd, and melt the solder with torch flame applied underneath the metal.

4. Remove the excess metal protruding at edges 9b-cd, Sketch G, and file to desired shape, as indicated in the cross section f-g. Also file the ends of reinforcement along edges ae-ec-bd to a beveled contact as indicated in Sketches H and J.

5. With the reinforcement on the bottom, place the blank on the contour block and shape the bowl in the cavity with the ball pein hammer. See Sketches K and L.

6. Solder initial to handle.

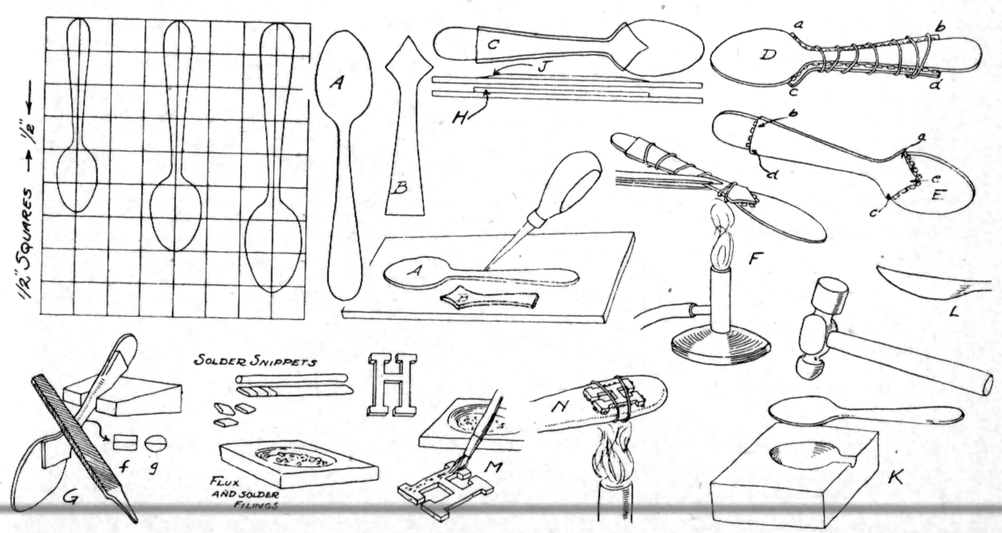
a. Apply flux to contact point on handle, also to under side of initial.

b. Sprinkle solder (fine filings) 70-30 into the flux on the initial or overlay. The solder will be held by the flux until the initial is reversed and placed in position. See Sketches M and N.

c. Secure initial or overlay in desired position with binding wire. See Sketch N.

d. Surround the initial letter with more solder filings, and apply heat to the under side of the spoon handle until the solder melts and is drawn under the letter.

7. True up any irregularities in edge contour with a file. Apply fine emery cloth moistened in oil (olive or light machine oil), and finish with pumice and water.



METAL WORK

Pewter

PROJECT NO. 5—PITCHER WITH HOLLOW HANDLE

Tools: Ball Pein Hammer, Wooden Mandrel, Metal Shears, Scratch Awl, Jeweler's Saw, Iron Binding Wire, Pliers, Alcohol Torch. Files: Flat and Half Round, Single Cut, Rough and Smooth Cut. Abrasives: No. 000 Steel Wool, Emery Cloth. Patterns: Body, Handle and Spout, Style A and Style B.

Materials: One Sheet Hoyt Pewter, No. 1 Britannica, 18 Gauge Solder; 50-50 and 70-30 in wire form 1/16" diameter, soldering flux. (Ten drops hydrochloric acid per ounce of glycerine.)

PATTERN DEVELOPMENT FOR 1/4 PINT PEWTER PITCHER

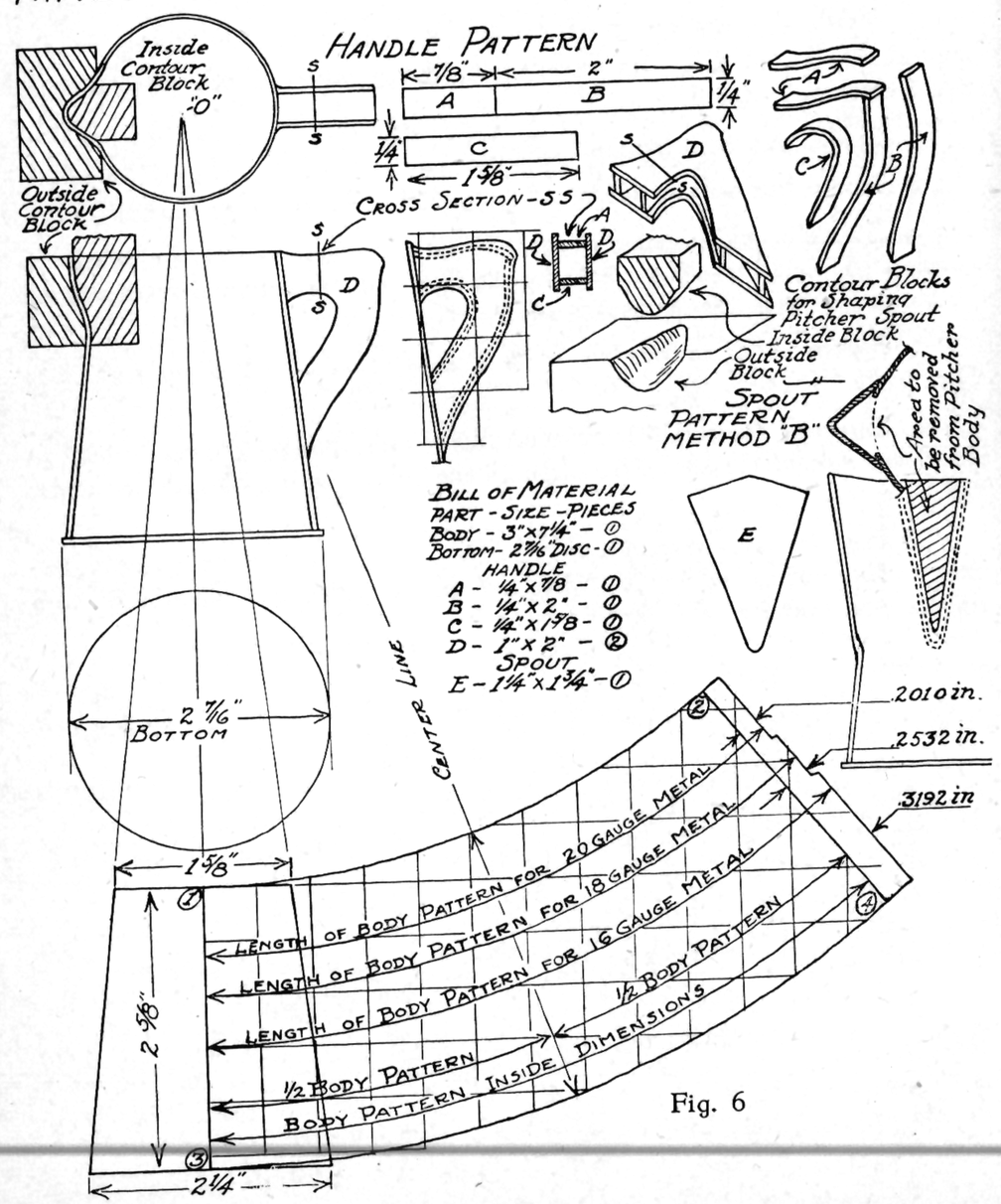


Fig. 6

METAL WORK

Pewter

Instructions:

1. **Transfer Pattern Outline and Cut Metal.** Place the cardboard patterns on the sheet of pewter, so as to utilize the smallest area with the minimum waste. Scribe the outline of each part with the scratch awl. Cut the pieces apart with a jeweler's saw and trim the exact outlines with the shears. True up any rough edges with a file as indicated in Fig. 7, Sketches A-B-C-D.

2. **Form the Body** of the pitcher around the mandrel by hand. Tap the edges together with a hammer to form a butt joint. Remove the cone shaped body from the mandrel, and apply binding wire to hold the edges together until the joint is soldered. See Sketches G to N, in Fig. 7 for details in using the binding wire.

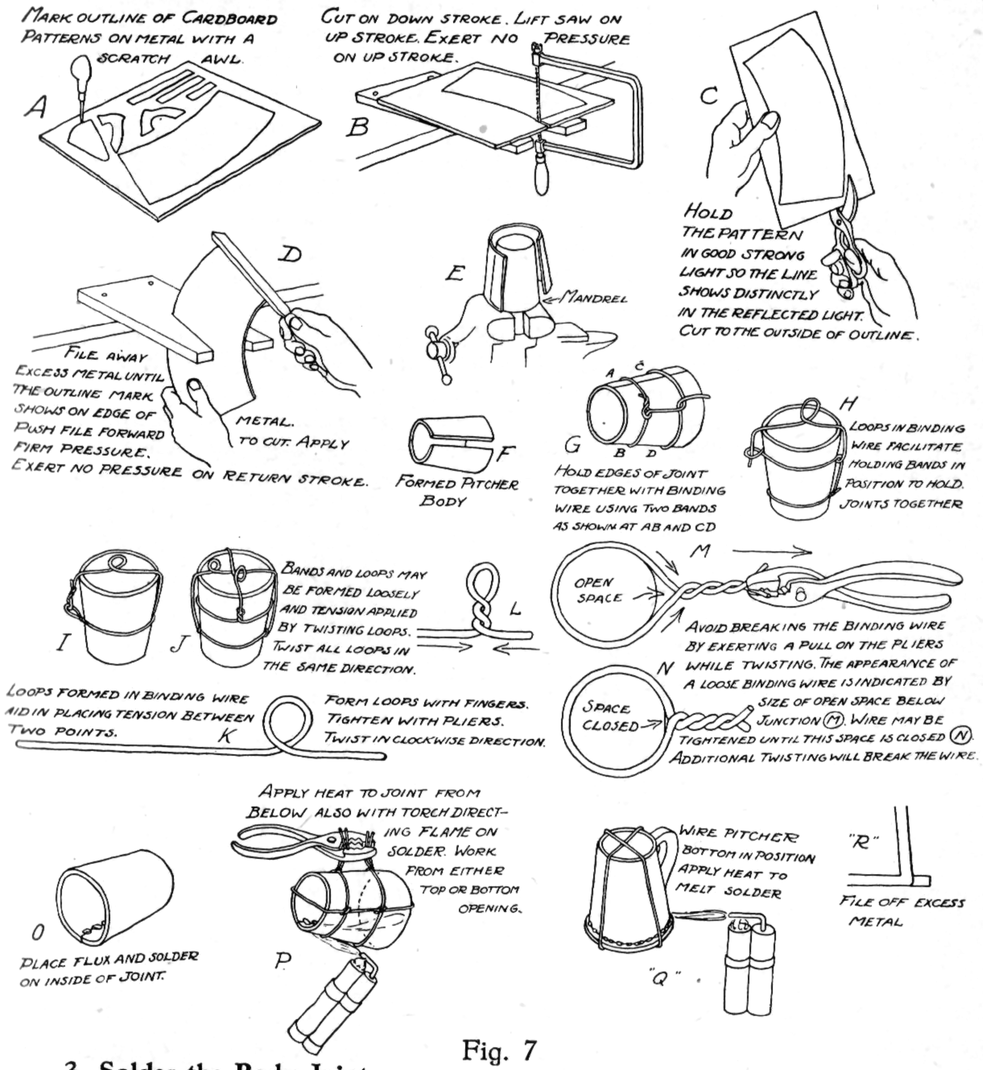


Fig. 7

3. **Solder the Body Joint.**

A. Flatten the wire solder to keep the pieces from rolling off the joint (use hammer or plate roll), and cut into snippets 1/16" to 1/8" in length, of both the 50-50 and the 70-30 specifications, and keep them separated. See paragraph D for the melting points of these solders.

B. Apply the soldering flux to all parts of the joint with a small brush.

C. Place snippets of the 50-50 solder along the joint on the inside of the pitcher, spaced about ⅛″ apart as indicated in Sketch O.

D. Apply the flame of the alcohol torch to the outside of the joint as shown in Sketch P. **Caution.** Keep the flame moving to avoid overheating. Britannia melts at 450 degrees Fahrenheit, and the 50-50 solder at *414 degrees Fahrenheit. As soon as the solder has melted and filled the joint, remove the binding wire.

4. Solder the Bottom Joint. See detail, Fig. 7, Sketch Q.

A. Place the cone shaped body on the pewter disc, cut with a diameter ⅛″ larger than that of the body, which is to form the bottom. Inspect for contact, and true up the edges of the cone if necessary to give uniform width of joint. The space may be gauged by the amount of daylight which shows through the joint. The care exercised in fitting the joint facilitates the soldering operation and insures a tight seam.

B. Apply binding wire to hold the body and the bottom disc together.

C. Brush flux well into the joint and place snippets of 70-30 solder about ⅛″ apart and in contact with both the disc and the pitcher body.

D. Apply heat from below and on the edge, moving the torch flame ahead from the melting solder. Remove the binding wire.

5. **Trim off the excess metal** from the protruding disc bottom with a file and slightly round the lower edge of the disc, as indicated in Sketch R.

6. **Assemble the Handle.** Sketches A to H, Fig. 8.

A. Cut two side pieces 1/16″ larger than the outline of the handle. Cut two spacers, pewter strips ¼″ wide and long enough to fit the inside and outside contours of the handle, parts a-b-c.

B. Bend the spacer strips to fit the handle contour. Make the corner bends a lap joint, Sketch A. Follow progressive detail, Sketches B to F.

C. Bind with wire to hold both side pieces and spacers in position.

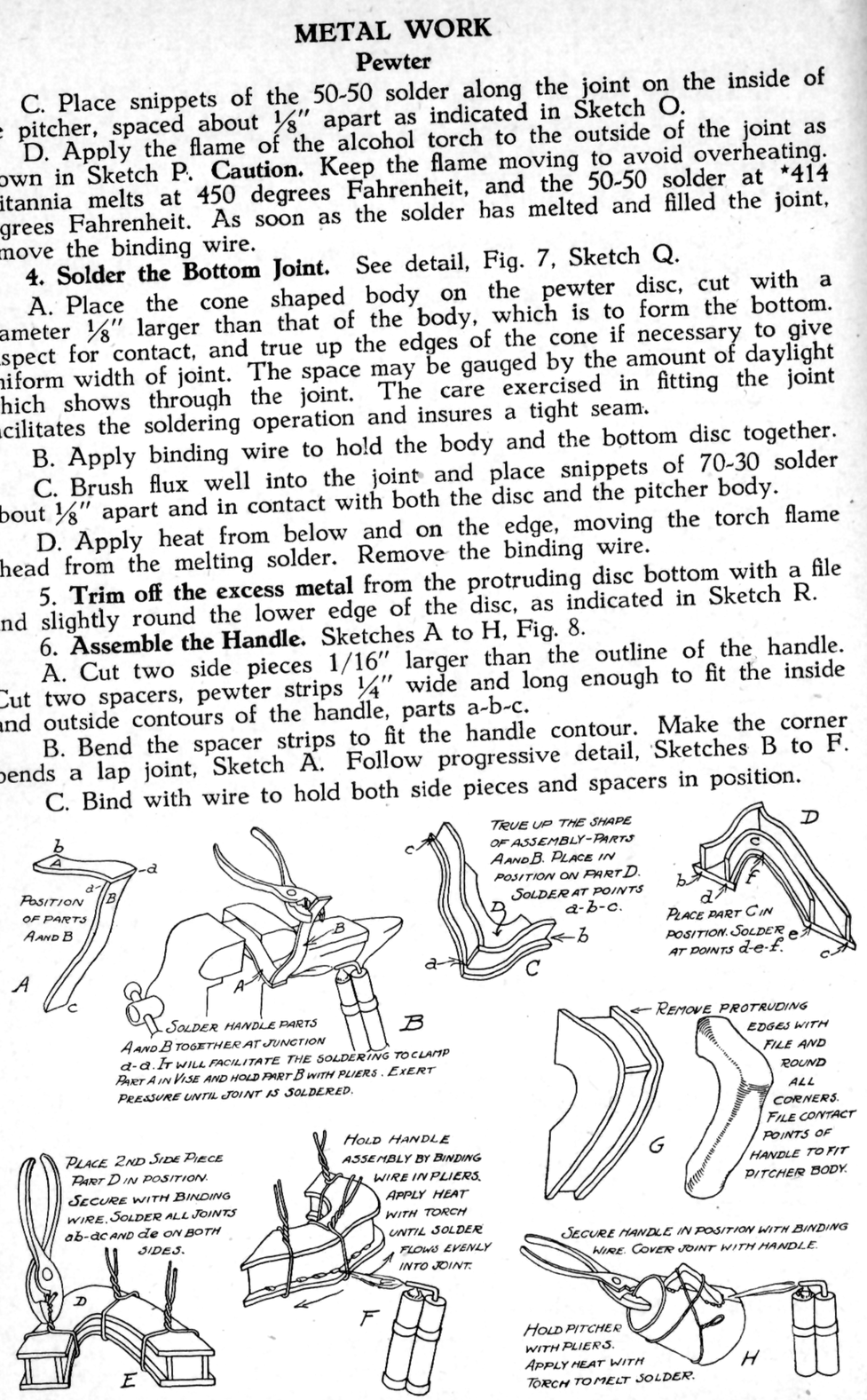


Fig. 8 *See Table of Melting Points, page 170.

7. Solder Handle Joints.

A. Apply flux to edge and place snippets of 50-50 solder along the protruding edge as shown in Sketch F, and solder each edge in turn.

B. File protruding edges to give a round corner, Sketch G.

8. **Attach Handle.**

A. File the contact points of the handle to fit the body of the pitcher.

B. Bind handle to the body with binding wire.

C. Apply flux and solder with 70-30 solder as indicated in Sketch H, Fig. 8.

9. Formation of Spout. Style A—Form the spout from the body metal in a contour block, Sketch A, Fig. 9.

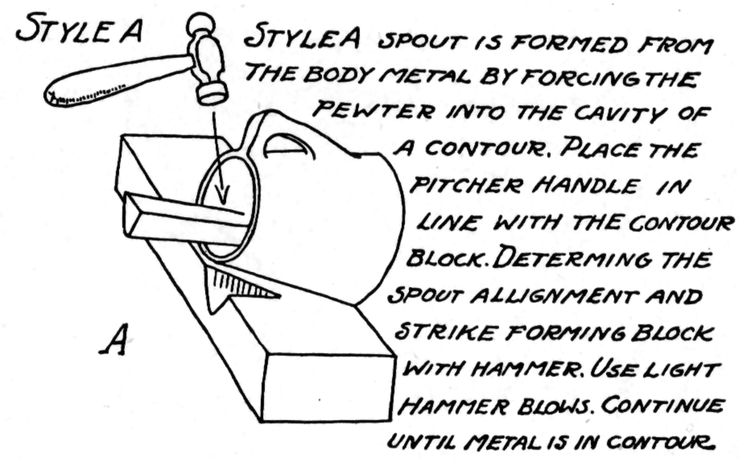


Fig. 9

10. **Finish all Surfaces.**

B. Apply fine emery powder to soldered joint, using a piece of buckskin stretched over the edge of a file. The buckskin should be moistened in water or light machine oil to carry the emery.

To Obtain High Polish, rub with buckskin charged with jeweler's rouge (tripoli), or buff on a rag wheel charced with tripoli. Clean with soap and water and polish with a soft cloth.

To Obtain a Matt Surface or Dull Finish, rub with emery cloth or powdered emery and oil, then with pumice powder and water. Clean with soap and water and polish with a soft cloth.

Pewter

11. **Cut and Solder Spout, Style B.**

A. Place cardboard pattern of area to be removed from the pitcher body in position, Sketch B, Fig. 10. Mark the outline with a scratch awl.

B. Place the fitted spout, Sketch D, on the pitcher body in the correct position and mark its outline inside and outside of the spout.

C. Remove the metal from the pitcher body within the V of the spout area with the saw, cutting inside the marked outline to allow sufficient edge to protrude and form a base for a butt joint as indicated in Sketches B, C, E. Shape spout and file to proper contact.

D. Bind the spout in position on body as indicated in Sketch F.

E. Apply flux to the joint and place snippets of 70-30 solder in position as shown in Sketch F. Apply flame as indicated.

F. Remove binding wire and smooth protruding edge inside spout with the half-round file, as indicated in Sketch G.

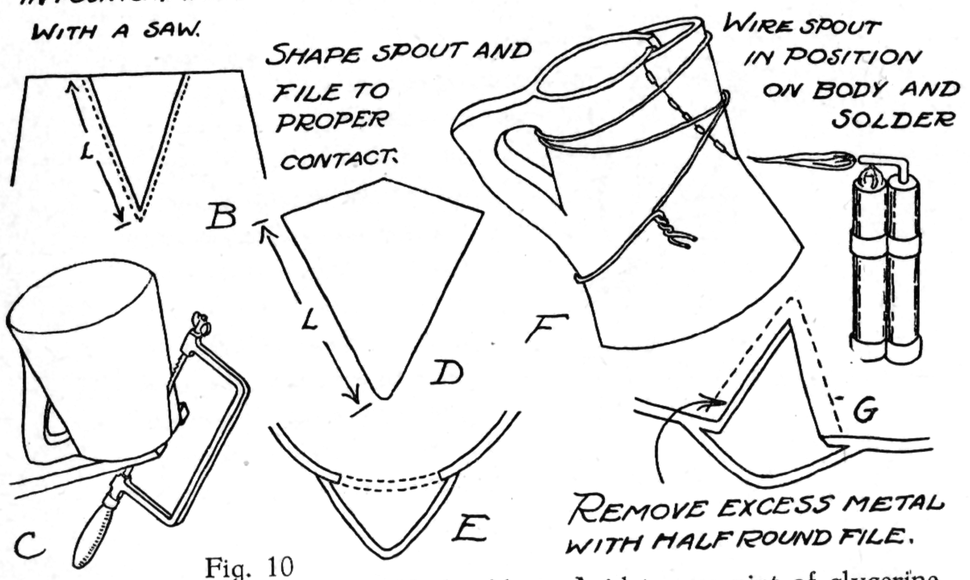


Fig. 10

*Soldering flux—1 tablespoon Hydrochloric Acid to one pint of glycerine.

Soft Solders

Percentages		Melting Point		
Tin	Lead	Degrees F.	Hardness	Remarks
0	100	620	3.9	
100	0	450	4.1	
33	66	491	15.8	Common Plumber's Solder
50	50	414	12.7	Medium
60	40	369	14.7	
66	34	356	16.7	Fine
70	30	365	15.8	

No. 3 Hoyt's Pewter—93 per cent Tin; 5 per cent Antimony; 2 per cent Copper. Melting Point 425 to 440 degrees Fahrenheit. Hardness 28.6 at 70 degrees F.

DEVELOPMENT OF PATTERN FOR PITCHER

I. Determine Pitcher Dimensions.

The elements of design may be visualized in the development of a pattern for a pitcher. The size should be determined by consideration of utility. For an illustration the requirement of material conservation may be satisfied, without loss in technique or teaching procedure, by the choice of a small cream pitcher.

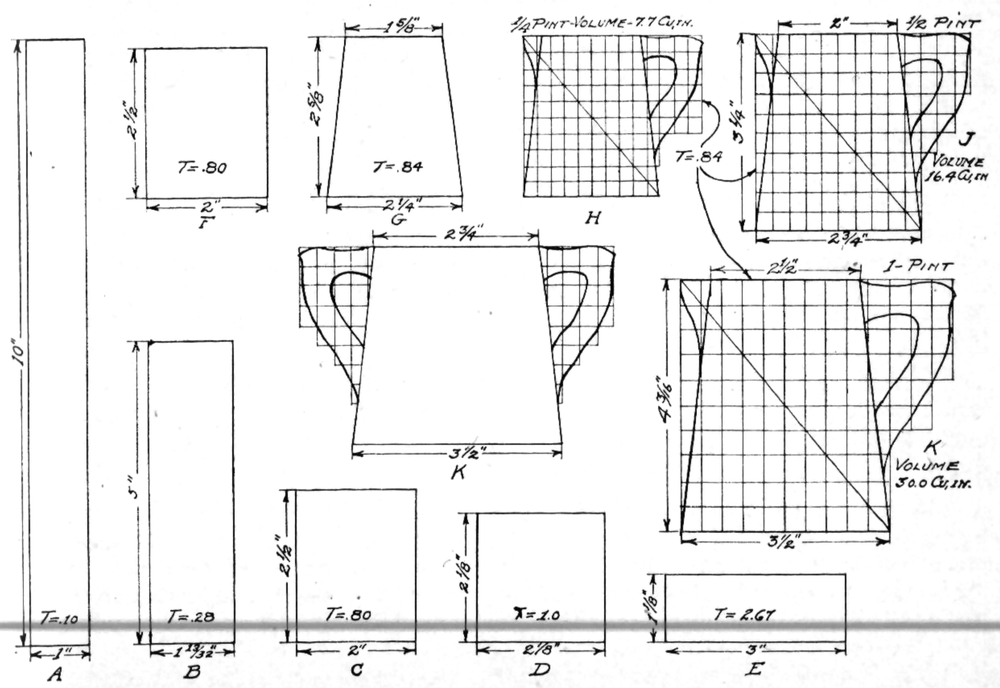
As a starting point for size determination let us select the smallest commercial unit in which cream is marketed and develop a design for a one-quarter pint capacity cream pitcher.

There are two approaches to this problem. 1—The method of approximation by which the dimensions of the pitcher are visualized in comparison with the ¼ pint cream bottle. The specifications for a pitcher of this capacity are estimated as approximately the diameter and height of the bottle. 2—The precise method of ascertaining specifications which is based on volumetric calculation.

The Calculation of Volume or Capacity requires the information given in a table of weights and measures, which may usually be found in almanacs, dictionaries, encyclopaedias, scientific handbooks or other tabulations of useful information. The table for liquid measure gives the following data: 1 U. S. gallon equals 231 cubic inches, 4 quarts equal 8 pints. From this data the volume of a pint is found to be 28.875 cubic inches. Since the pitcher must be large enough to permit pouring from it when it is filled with ¼ pint of cream, a minimum volume of 7.5 to 8.0 cubic inches is taken as the capacity. Similarly the volume for a ½ pint pitcher would be 15 to 16 cubic inches and for a pint size 29 to 30 cubic inches. To these figures for the pitcher body will be added the volume of the spout.

II. Select Shape of Suitable Proportions.

Several shapes and forms of containers are considered which have a capacity of ¼ pint or 7.854 cubic inches. Fig. 11 shows a range of five cylindrical shapes, each having a capacity of 7.854 cubic inches. Selection is based first, on the condition of suitability for the purpose intended, and the consideration of stability must be satisfied. Fig. 11.



METAL WORK

Development of Pattern for Pitcher

Sketch A represents a cylindrical container 1 inch in diameter and 10 inches in height; Sketch B, one which is 1-13/32" by 5"; Sketch C, one of the dimensions, 2" in diameter and 2½" in height, Sketch D, a cylinder 2⅛" in diameter and 2⅛" in height, and Sketch E, one which is 3" by 1⅛". Shape A is rejected primarily on the basis of instability, although there are other factors which mark it as unsatisfactory. The incongruity of a pitcher of half this height, as shape B, is somewhat lessened but present in a degree sufficient also to warrant its rejection. All three shapes C-D-E come into the field where the stability factor is satisfied, so selection here is governed by the aesthetic factor of harmonious proportion.

A choice of the shape shown by Sketch D, which is a square, will be avoided because of its uninteresting lack of symmetry. Its position in the center of the utility range is known by designers as the "static" or area in which all those dynamic forces present in the other areas are lacking. These forces which determine a pleasing design are governed by a relationship of height and width. Further information on this basic principle of design will be found on page 22 in the section on design.

Shape E, while possible from a standpoint of utility, does not satisfy because this shallow and squat form seems a distorted and inharmonious proportion. The remaining shape, C, conforms in its height-width relationship to the acceptable ratio for a rectangle. The width is .80 of the height.

In Fig. 11, Sketch F, is shown a cross section of cylinder C, an area 2½" high and 2" wide which corresponds to the pleasing height-width ratio of .80. Since the cylindrical shape is not suitable for a cream pitcher, the proportions are modified to the conical shape nearest in capacity to the ¼ pint cylinder as shown in Sketch G. This shape is 2¼" diameter at the base, 1⅝" at the top and 2⅝" in height. This proportion has a ratio of .84 and the volume is 7.7 cubic inches.

The Metrical Net constructed as shown in the Sketch H, Fig. 11, is a device for transferring proportions from the pitcher body to the handle. A few meshes have been transferred to the right of the original rectangle. This serves as a field in which a handle has been drawn freehand. This appendage may be developed to suit individual taste. The resulting contours within the meshes of the metrical net are in harmony with the main theme of primary mass. This Sketch now embodies the specifications for a ¼ pint pewter pitcher. The width is .84 per cent of the height.

Sketch H shows the horizontal lines drawn and the rectangle subdivided into small rectangles, each having a width and height equal to 1/10 of the corresponding dimension in the original rectangle, so that the height-width ratio (width divided by height), is the same for each of the 100 rectangular divisions, as for the original primary mass. Each rectangle has a ratio of .84.

These rectangles are frequently referred to as the "meshes" in a "net" which visualizes a fish or a tennis net in which the openings or meshes are surrounded with string or cord. Hence the analogous term Metrical Net is applied to a rectangle divided in this manner.

A further extension of this study is shown in Fig. 11, Sketches J and K, patterns for both a ½ pint and 1 pint pitcher, also a sugar bowl companion piece for the ½ pint creamer. All of these specifications have been developed for a mesh ratio .84. A comparison of unit meshes used in metrical nets for these other pieces is shown in Sketches J and K.

Pattern Development from Primary Mass

The primary mass selected for the pitcher is shown in Fig. 11, Sketch H. Redraw this pitcher shape shown in Fig. 6. Extend the sides to the point of intersection O, Fig. 6.

From O as the center and the radius length O-1, scribe an arc indicated in between the points 1-2. The length of this arc should be approximately 3½ times the diameter of the pitcher top. In the same manner scribe another arc between the points 3-4. These arc lengths which form the top and bottom of the pitcher pattern should be exactly determined by calculation using the formula. Circumference equals Pi (3.1416) x Diameter, or $C = \pi \times D$.

The relationship of diameter (D) and the circumference (C), of circles is expressed in the equation $C = \pi D$, where π or Pi is the symbol meaning that the circumference is a length approximately 3-1/7 (3.1416 plus) times the diameter.

A piece of pliable cardboard ¾" wide on which the computed lengths have been marked, makes a useful device for transferring these dimensions to the respective arcs. It is necessary to place the cardboard on edge to accurately transfer the arc lengths marked on the cardboard to the pattern. With the initial point on the cardboard scale opposite point 1 on the pattern, hold it in contact with slight pressure exerted by the left hand.

Curve the cardboard ruler into contact with the arc, an inch or more at a time, until the line which indicates the end of the arc appears, and mark its position on the pattern. Repeat this procedure to determine the length of arc 3-4.

A line drawn through the points 4-2 should pass through the center 0 when the lengths of these arcs are accurately determined. The area enclosed between these arcs and radial lines 1-2 and 3-4 is the outline of the pitcher pattern. Since this is the area of the inside of the pitcher its size must be increased to give outside measurements. The outside of the pitcher is larger by an amount which varies with the thickness of the metal used. In each pattern beyond line 2-4, the actual additional length required for correct pattern size for metals of different thickness is shown.

The standard scale for measuring the thickness of sheet pewter and other craftwork metals, also diameters of wire, is known as the Brown and Sharp gauge. According to this scale the relationship between thickness, gauge number, also the amount of extra length which is required for each metal thickness in constructing circular or conical containers is given in the pattern sheet.

In determining inside and outside dimensions the following formulae may be used.

C_I equals Circumference Inside

C_O equals Circumference Outside

D_I equals Diameter Inside

D_O equals Diameter Outside

T equals Thickness of Material

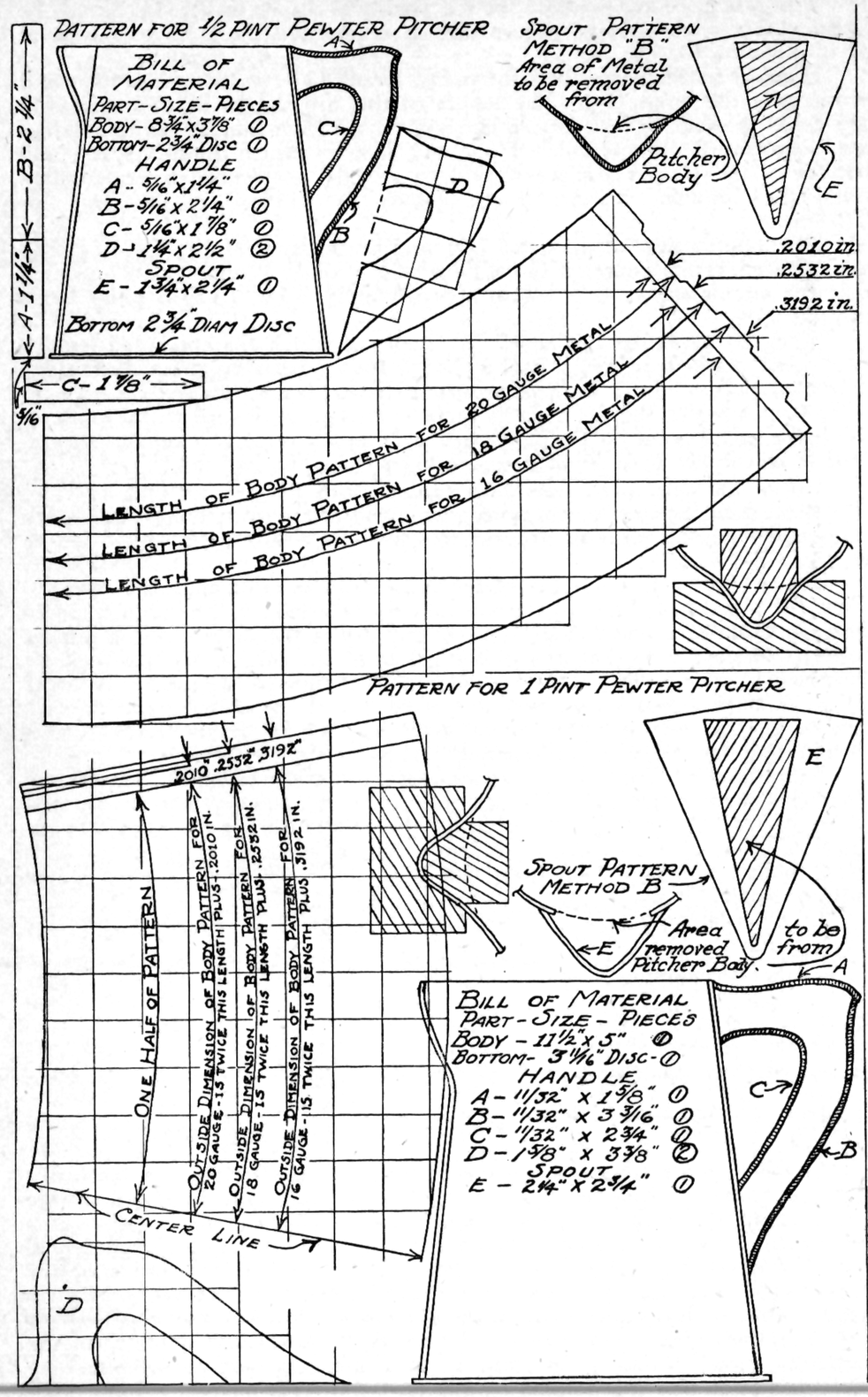
$\pi = 3.1416$

$$C_I = \pi D_I \text{ and } C_O = \pi D_O, \quad D_O = D_I + 2T$$

$$D_I = \frac{C_I}{\pi} \quad D_O = \frac{\pi}{C_O}$$

$$C_O = \pi \ (D_I + 2T)$$
$$= \pi D_I + 2\pi T$$
$$= \pi \frac{C_I}{\pi} + 2\pi T = C_I + 2\pi T$$

In other words when the thickness of the metal is known and the inside of the container determined, the length of the pattern may be found by the above formula, which gives the length of sheet metal required to cover a cylindrical shape. To the circumference of the shape is added a length equal to 6.2832 times the thickness of the metal. The pattern length measurements obtained by this formula, although mathematically correct will make an article with slightly increased inside dimensions, due to the elasticity or stretch of the metal. This factor varies with thickness and ductility of the particular metal. Greater precision in measurements may be obtained by experimentation and fact finding by the trial and error method. Our experience with Pewter shows the added length varies between 4.0 and 6.0 times the metal thickness instead of being 6.2832 (the theoretical figure) times the metal thickness.



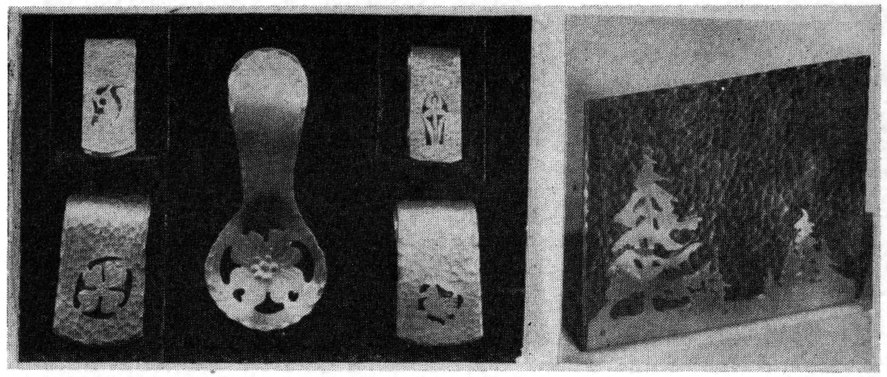
METAL WORK

Pewter

Project No. 6—Napkin Clip—Pierced Decoration

Tools: Ball Pein Hammer, Anvil or Flat Metal Surface, Wooden Mallet. 5" Jeweler's Saw. Saw Blades No. 000 or No. 0000. Hand Drill—1/32" bit. Files: half round, flat, single cut. Carbon Paper, Flat White Water Color Paint, Metal Scriber and Tracer, Center Punch or Nail Set. Abrasives: No. 000 Steel Wool, Emery Cloth and Oil, Powdered Pumice.

Materials: Hoyt's Pewter, No. 3 Britannia, 16 gauge.



Instructions:

1. Cut a strip of pewter 5½" long and 1⅛" wide, tapered to ⅞" at the narrow end.

2. Remove the rough edges with a file and restore flatness of the metal with a wooden mallet.

3. Transfer the design to the metal.

a. Coat the surface to be decorated with a thin wash of the flat white and permit it to dry.

b. Transfer the design to the coated surface with carbon paper (metallic carbon if available), using a sharp, hard pencil or a smooth metal tracing tool.

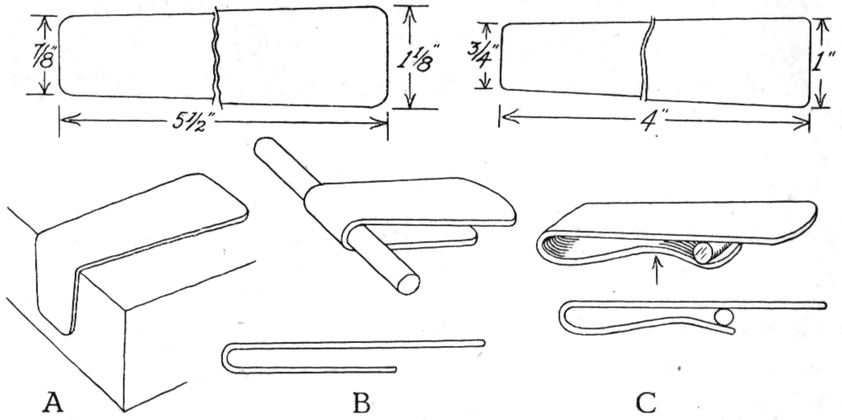


Fig. 12

4. Drill holes for the insertion of the saw blade and saw the design outline.

5. Scribe the design detail with a sharp metal scriber (scratch awl). Stamp the flower center with center punch or nail set.

6. Remove the white surface coating with water and apply steel wool to all edges.

7. Hammer the surface and edge with the ba'l pein hammer. An alternate edge finish is shown on the nut spoon illustrated.

Pewter

Regular blows with the flat end of the hammer are applied along the margin to produce the slightly scalloped effect. As shown this finish is effective on either surface, hammered or plain. Note also that the same flower motif used in the nut spoon has a raised center produced with the center punch applied from the back before the bowl is shaped, with a sheet of soft lead underneath.

8. True up any irregularities or roughness in edge contour with file. Apply fine emery cloth moistened in oil and finish with powdered pumice and water. If a high polish is desired use crocus or jeweler's rouge on a cloth or buckskin.

9. Bend the clip into shape, Sketches A, B and C.

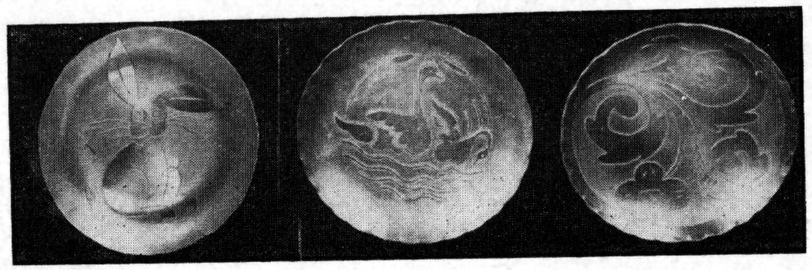
a. Make a right angle over the edge of a table, Sketch A.

b. Complete the bend over a dowel placed in the position indicated in Sketch B.

c. Place a wooden dowel between the open ends and press in the direction of the arrow. Sketch C.

The photograph shows several napkin clips and a nut spoon. Pierced decoration using floral and animal motifs have been used. The design elements within the central areas and between pierced openings have been preserved by scribed lines. The floral centers have been indicated by the use of a center punch or nail set applied to the surface or raised from the back. Plain and hammered surfaces are shown with edges finished in the hammered or a scalloped effect.

Project No. 7—Raised Tray, Etched Decoration



Tools: Raising Hammer. Ball-Pein Hammer, Stake, Flat File Single Cut, Metal Scriber (scratch awl). *Flat White (water soluble.) Abrasives: No. 000 Steel Wool, Fine Pumice, Jeweler's Rouge (crocus). Asphaltum Varnish. Small Round Brush No. 1 or 2. Turpentine, Acid Bath—4 parts water, 1 part nitric acid. Glass containers for acid bath and turpentine. Paper towels.

Material: 3″ or 5″ disc. Hoyt's No. 3 Pewter—18 gauge.

Instructions:

1. Mark a circle on the disc. 1½″ in diameter for the 3″ disc or 3″ for the 5″ size, for a guide line to be followed in raising the tray, Sketch A.

2. Place the stake on its pedestal, Sketch B. Hold the disc against the stake as indicated in Sketch D, with the guide line in contact with the upper part of the stake.

*Two drops of Aersol OT-10% added to an ounce of water will reduce the surface tension; and permit a polished metal surface to be coated uniformly with the flat white.

3. Strike the disc with the raising hammer just outside the guide circle. The approximate position of the hammer stroke and disc are shown in Sketch E. Rotate the disc with the left hand. A rhythm count of three consecutive, slightly overlapping strokes is used by professional craftsmen skilled in the art of raising a "shape" from sheet metal. Continue the process of concentric hammer strokes, rotating the disc between the three strike rhythm blows, until the edge is reached. Four rows should be sufficient for the 3″ tray which appears as indicated in Sketch G.

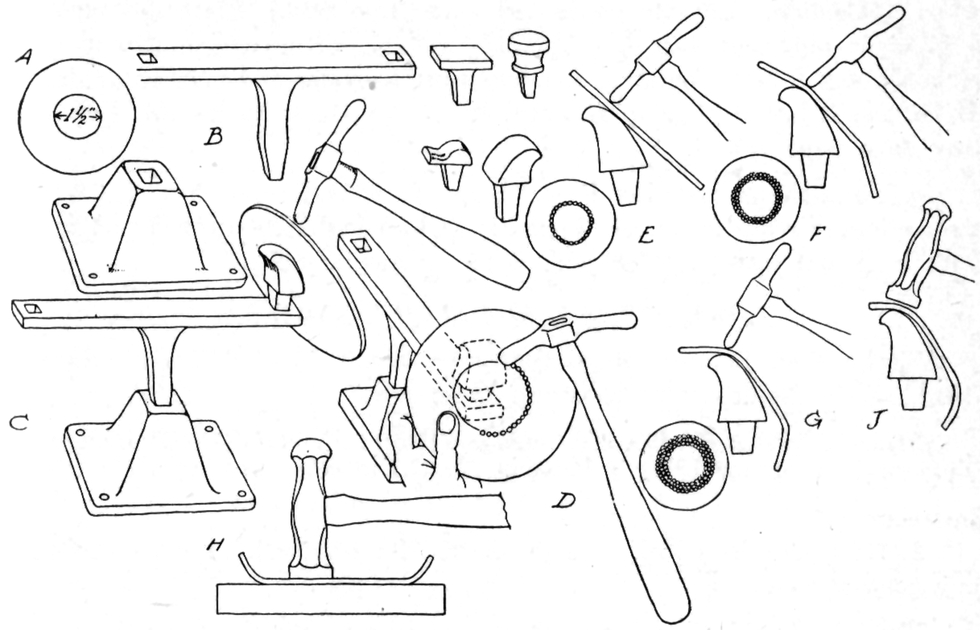


Fig. 13

4. True up the edge with a file. The tendency of the center or bottom of the tray to cup may be corrected by hammering it flat on a level surface with the pein or flat end of ball pein hammer, Sketch H.

5. Place the tray on the stake and with the pein end of the hammer, or with a planishing hammer smooth out or reduce to a plain surface the contour of the tray. This flat ended hammer irons out or planishes the hammer marks made in "raising" the tray. Carefully planished surfaces resemble rolled sheet metal in texture, with only faint traces of the hammer marks discernible.

6. Finish the tray inside and outside with steel wool, followed by pumice and water, then tripoli on buckskin or cloth for a dull or matt finish, crocus for a luster polish. Wash with soap and water.

7. Etching Procedure.

a. Coat the inside of the tray with water soluble flat white paint.

b. Transfer the design to the white surface with carbon paper and a sharp, hard lead pencil.

c. Trace the design outline with the metal scriber. Actually scratch a slight but clean cut V shaped continuous grooved line into the metal.

d. Remove the white surface coating with moistened cloth. Inspect all lines for uniform depth.

e. Apply the acid resisting asphaltum varnish to all parts of the design except the background lines or other elements of the design which are to be etched. This may include the bottom of the tray as may be desired. Permit the asphaltum varnish to dry, at least an hour. With the metal scriber, redefine all lines within the coated area that are to be etched.

f. Make an acid bath by pouring one part acid into four parts of water. (**Caution,** acid into water, **not** water into acid.) Place this bath in a glass or porcelain dish, large enough to take the tray, and permit it to remain about 8 to 10 minutes. Remove, rinse in water and inspect the depth of etching. (Just enough to feel with the finger tip is sufficient.) Dry the tray on a paper towel.

g. Place the etched tray into a bath of turpentine which will dissolve the asphaltum varnish, about 5 minutes. Clean with paper towel and wash with soap and water. Polish with tripoli or pewter polish.

PROJECT NO. 8—CANDLE STICKS

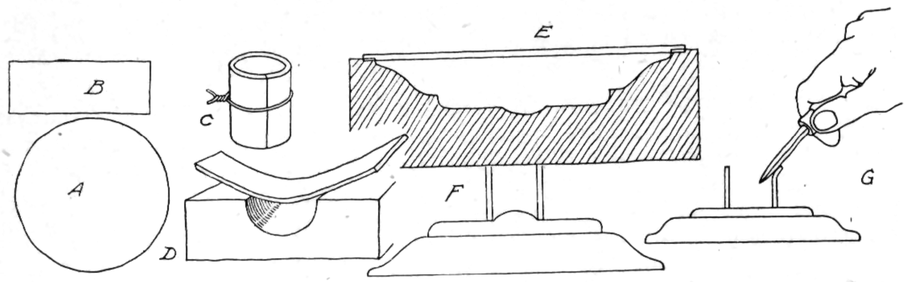
Tools: Ball Pein Hammer, Burnisher, Small Alcohol Torch Contour Block. 70-30 Solder and *Soldering Flux.

Material: Two 3″ Discs 18 gauge (Hoyt's Pewter) No. 3 Britannia. Two strips 18 gauge (Hoyt's Pewter) No. 3 Britannia, 1¼″x2½″.

Instruction:

1. Raise the discs to the height desired for candlestick base, and shape in a contour block.

True up the edges and level the top and base. Slightly dome the center of the top by pressing into the cavity in the contour block, see Sketch E.



2. Make the candle holders by bending the strips into cylinders. Make a butt joint, secure with binding wire and solder with 70-30 solder. (See soldering process detail on page 168.

3. File each end of the cylinder flat and place it upon the base. See Sketch F. Solder in place.

4. Flare the top of the cylinder with the burnisher, by repeated light strokes applied as indicated in Sketch G.

5. Finish as desired, see page 169 for procedure.

*See page 170.

PROJECT NO. 9—NUT BOWL, LATHE SPUN PEWTER

Tools: Lathe, face plate, follow block and thrust bearing, spinning tool and rest, contour block, centering block. Single cut file.

Materials: A 5 ″ disc of No. 2 Pewter, 16 gauge. Abrasives: No. 000 steel wool, Jeweler's rouge on buckskin, No. 0 pumice stone, hard motor grease.

Instructions:

A. Setting up of Lathe.

1. Attach contour block to the lathe spindle.

Method a—Screw contour block, tapped to fit the threaded spindle, to the lathe head, See Sketch A.

Method b—Attach face plate with wooden screws to the contour block, then screw it to the lathe head. See Sketch B.

2. Insert follow block, thrust bearing and taper shaft in the lathe tail stock and move tail stock up in contact with the contour block. Clamp the tail stock in this position.

3. Place spinning tool rest, Sketch D, in tool post, adjust to height required to make contact of spinning tool come on lathe center line. See Sketch E.

4. Loosen follow block with hand wheel of tail stock sufficiently to permit inserting the pewter disc, Sketch F, between it and the contour block. Place the disc in approximately the correct position between the two blocks. Tighten the hand screw on the tail stock just sufficiently to keep the disc from dropping down on the lathe bed. See Sketches G and H.

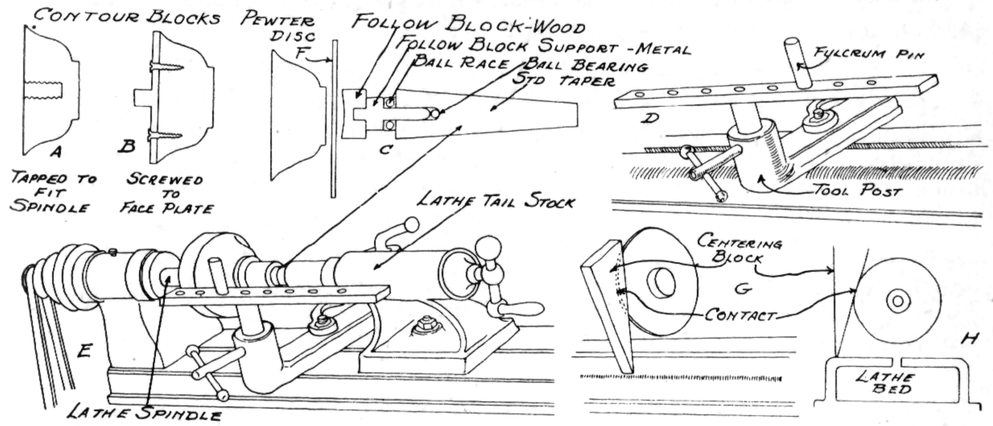


Fig. 14

B. Spinning Operation.

1. Place the wooden centering block in the position shown, see Sketches G and H, and start the lathe with the block in contact with the edge of the disc. Only slight pressure of the centering block is required to move the pewter disc into the correctly centered position. As soon as the disc runs true and while the centering block is still in contact with the disc, increase the pressure of the follow block until the disc will continue to run freely when the centering block is removed.

2. Apply a little hard grease with a cloth to the surface of the disc, to lessen the frictional contact with the spinning tool.

3. Place the fulcrum pin in the tool rest, position as indicated in Sketches D and E, and start spinning. Sketches No. J to O, Fig. 15, show the spinning procedure. After the pewter disc has been pressed into contact with the contour block, slightly cupped as in Sketch K, check the pressure of the follow block to avoid overheating. Release it slightly but not sufficiently to cause slipping of the disc between the two blocks.

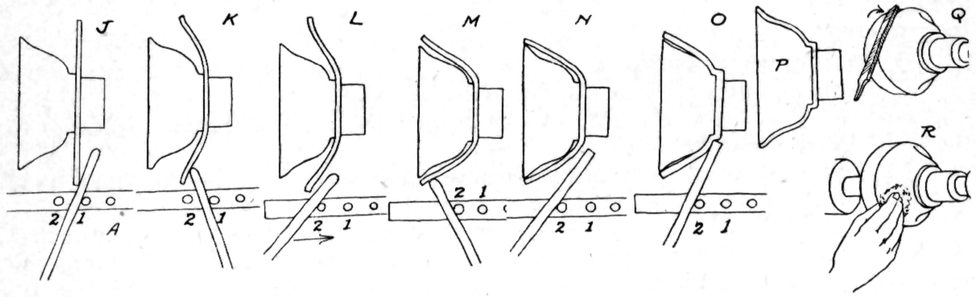


Fig. 15

4. Continue spinning, using the round end of spinning tool, Sketches A to D, until the disc has been pressed into contact with the contour block at all points Form the bottom of the bowl with the square end of the spinning tool. See Sketches N and O.

5. True up the edge of the bowl while the lathe is running with a file held in contact with the metal. See Sketch Q.

6. Remove any spinning tool marks or scratches from the outside of the bowl by holding a bit of No. 000 steel wool in contact with the metal while the lathe is running See Sketch R. Inspect the bowl for surface blemishes which may be ironed out with the spinning tool, before loosening the follow block to remove it. Sketch P shows bowl ready to be removed from lathe.

7. Rub the inside of the bowl with steel wool to produce a surface corresponding with the finish developed on the outside. In case a high polish is desired, jeweler's rouge (tripoli), applied with buckskin, will produce such a surface. A dull finish may be developed by rubbing with powdered pumice, No. 0 grit or finer, applied with a damp cloth or buckskin.

CASTING PEWTER

The supporting feet in Project 2, also the lifting knob in Project 3, are cast in a plaster of Paris mold.

Tools: Wooden patterns of shapes to be cast. (The method of making these patterns is given on page 190. One pound Modeling Clay, 1 pound Plaster of Paris, Base Plate of Marble or Glass about 8"x10", 4 strips of Sheet Metal 1½"x6" (galvanized iron), Crucible, Tongs, Parting Mixture, (1 pound soft soap, ¼ pound of tallow, 1 tablespoon baking powder).

Materials: Scrap Cuttings from sheet pewter.

Instruction:

1. **Mold Making in Plaster of Paris.** Place four rolls of modeling clay upon the base plate as indicated in Fig. 6, Sketch A. Form a box

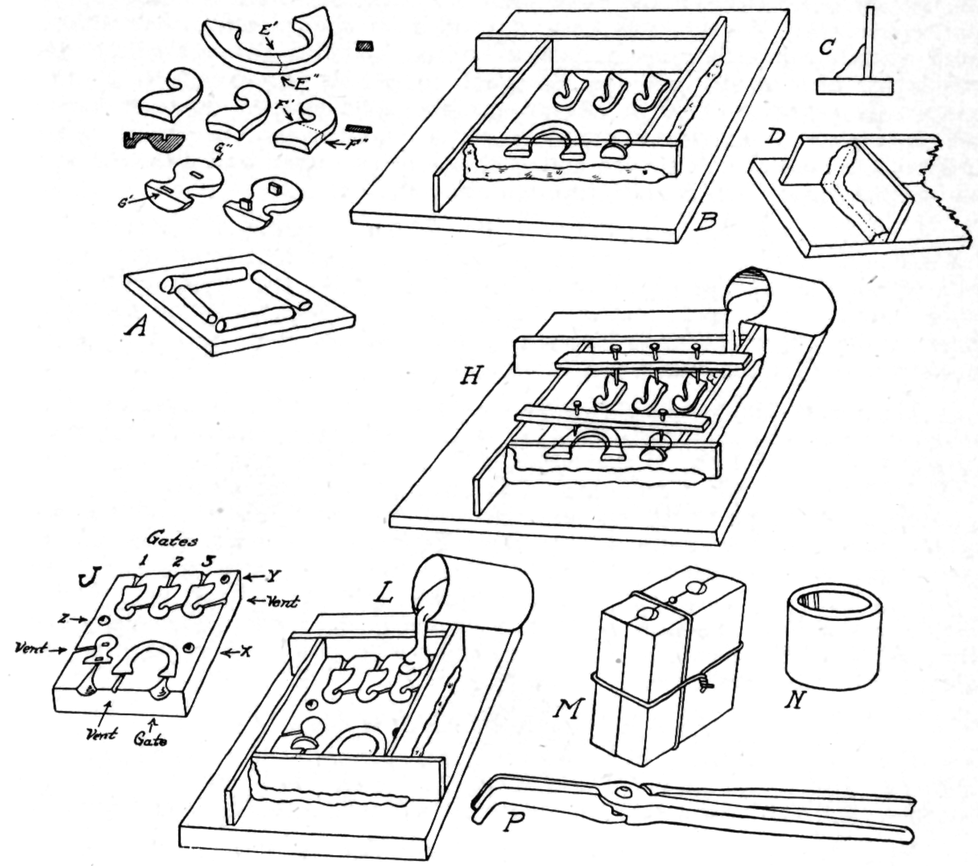


Fig. 6

with the four metal strips and hold them upright with the clay, which is pressed firmly into the corners between the strips of metal and the base plate. See Sketches B, C and D. The clay will hold the box together and seal all seams, making them water tight.

Sketch F shows patterns for the three supports used in Projects 2 and 3. These patterns are also tapered from bottom to top. Sketch G is a pattern of the knob for the cover in Project 3. This pattern is made in two pieces which are separated on the center line G-G. One half of the pattern is shown at H. Two holes are drilled in this pattern to receive short pins which are used to hold the halves in the proper position.

Place the several patterns which have previously been oiled (Olive or Wesson Oil) in the enclosure. The device shown in Sketch H is used to hold these in contact with the base plate while the Plaster of Paris is poured around them. Select a container which will hold about 1½ pints and fill two-thirds full with water. Slowly add ¼ pound of plaster paris, stirring constantly until the mixture reaches a creamy consistency. Addi-

tional plaster may be added if necessary, but the mixture must be thin enough to pour readily. Cover the patterns to a depth of about one-half inch, meanwhile hold them in contact with the base plate as noted under Fig. 6, Sketch H, page 181.

In about twenty minutes the metal strips may be removed and the plaster mold lifted from the base plate. This is shown in Sketch J. The patterns should appear uniformly imbedded in the plaster. Cut grooves with a knife blade to provide channels through which the metal flows into the mold, also small vents as indicated, to permit the escape of air and gases. At points X-Y-Z in Sketch J make cone shaped depressions into which cones of the corresponding shapes are cast when the upper half of the mold is made. This device makes it possible to open and close the mold and also insures both parts fitting closely together.

Replace the mold upon the base plate. After coating the surface with the parting mixture, put the metal pieces around the half mold and seal in place with the modeling wax as in Sketch L. Place the upper half of the knob pattern on the part imbedded in the plaster. Be certain that the dowel pins in the upper half are inserted in the holes of the lower half of the pattern and that the two parts fit snugly together.

Make a second mixture of plaster of paris and water as directed above and pour into the mold, Sketch L. Cover the handle pattern to the depth of about one-half inch. If the upper half of the handle pattern fits loosely hold it in place with a nail until it is covered with the plaster. After the plaster hardens, 15 to 20 minutes, remove the metal pieces and the wax which should be saved for future use. Separate the mold and lift the patterns out of the casting. True up any rough edges of the molds and open up the gate and vent channels which have been filled with plaster. Dry the molds in a warm place five or six hours before proceeding with the casting of the pewter. A wet mold is apt to crack when the hot metal comes in contact with the moisture.

CASTING IN A PLASTER MOLD

Prepare the molds for the metal by dusting them with powdered charcoal, pumice stone or talcum powder. Place the halves of the mold together and hold them in place with a cord or light wire. See Sketch M.

Place scrap cuttings of pewter in a crucible, Sketch N, and with the tongs, Sketch P, hold it in hot coals or apply the flame of a blow torch until the pewter melts. Pour a steady stream of the molten metal into the mold until the gate is filled. After a few minutes remove the fastening cord and separate the molds. Lift out the casting with pliers and when it is cool remove with a saw the metal sections formed in the gate channel and vents, also any excess metal which spreads between the molds to form "fins" at the mold joints.

PEWTER REFERENCES

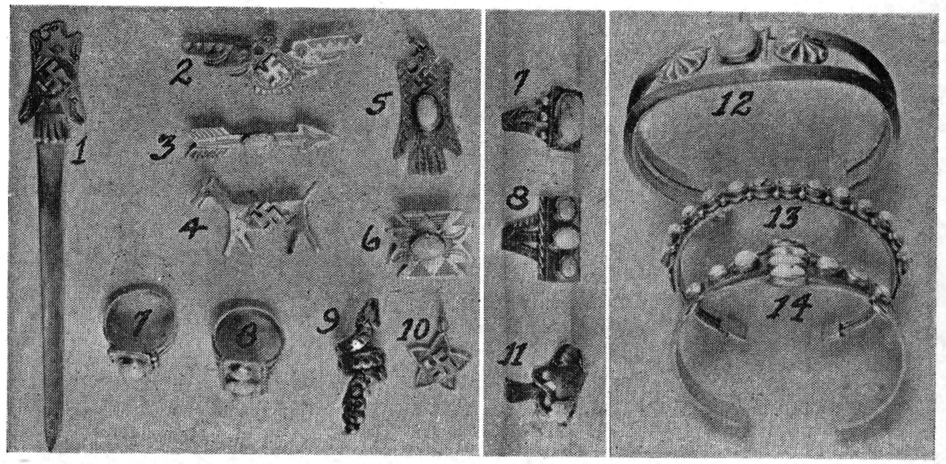
"PEWTER FOR TEACHERS AND STUDENTS OF THE ART CRAFTS IN SCHOOLS, COLLEGES AND CAMPS" — Folder distributed by the National Lead Company, 722 Chestnut Street, St. Louis, Missouri. It contains instruction in working pewter. Projects detailed are: Hammered Plate, for the beginner, Book Ends which introduce the soldering process and a Pewter Bowl produced by the metal spinning process.

"PEWTER DESIGN AND CONSTRUCTION" by William H. Varnum, Bruce Publishing Company, Milwaukee, Wisconsin, 1926. This book "links and articulates the best design with construction." It stresses "a survey of the historic side of pewter and the spirit controlling the work and the fine ideals of the Ancient Guild of Pewterers" A unique approach to designing appropriate to base metals is presented in a chapter on "Pewter in Contour and Tempo." The chapter on "Surface Enrichment of Pewter" should be read both for technique and inspiration. A list of reference books of interest to the collector is appended in this book.

The metal silver occurs in volcanic rocks and in ancient times was probably discovered when the rocks were broken down or worn away. Unlike gold, it is rarely found in the native state, and must be extracted from other minerals with which it combines. As one of the first known precious metals it is mentioned in the writings of Homer, who tells of temples and palaces with decorations of silver and gold, and the Bible relates that the Hebrews left Egypt with possessions of gold and silver in the 20th Century, B. C. Knowledge of smelting and working silver is thought to have been of Egyptian or Assyrian origin as was many other crafts, and the art came into Europe through the Roman conquerors who thus passed on the skill and knowledge which they acquired from other subject races. Pure silver is a perfect white metal surpassing all others in luster, but on account of its softness in the pure state is alloyed with a small percent of copper which hardens it and slightly dulls its brilliant color. For centuries the greater portion of the world's supply of silver has been mined in Mexico and from this country through the Yaqui and Navajo Indians a unique and distinctive craft has developed among the native Americans of the Southwest.

The use of silver for ornamentation among the Indian Tribes of our own Southwest and Mexico, antedates the arrival of the Spaniards. Bits of free silver were fashioned into ornaments by hammering, or by melting or casting into desired shapes. Apparently the knowledge of the art of soldering was contributed by the Spaniards. Later better tools were obtained from the traders, and much of the improvement in the art of the native silversmith is attributed to the introduction of fine files and emery paper.

Many of the primitive methods used centuries ago by the Indian Silversmith are still employed by the present day silver workers in the Pueblos and on the Reservations. Silversmithing in the primitive Navajo style has Handicraft values of a high order, but because of the skill and judgment required, might well be confined to the older group or made a



Silver

part of the Indian Lore Program. The Navajo method of working silver is described on pages 450-453.

The closer the approach to the Navajo method in all its primitive aspects the greater the fun and thrill to be derived. Mastery of the elemental processes and acquisition of skill in the use of the simple tools, brings a sense of appreciation of the ability and judgment of the Indian Craftsman.

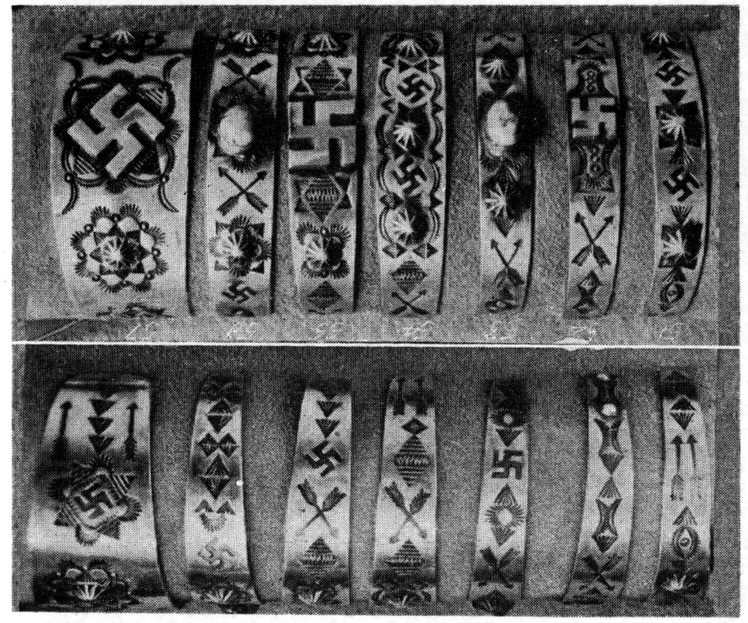
Modified Navajo Indian Silversmithing, using sheet metal and jeweler's tools and procedure is a Handicraft which offers a fascinating addition to the general handicraft program. The illustration shows projects made from rolled shapes or sheet metal blanks which are obtainable cut to shape. Procedure is detailed on pages 192-197.

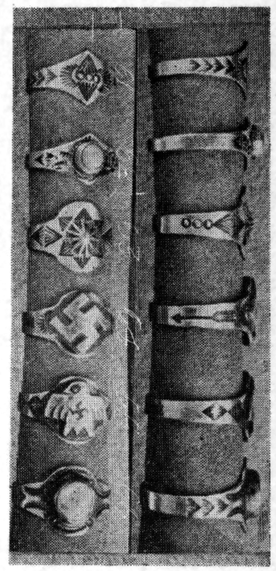
Silver is a most satisfactory metal for craftwork. Only through working with silver are the inherent qualities to be recognized and appreciated. Ease of manipulation, the variety of surface texture possible of attainment has made silver a coveted metal. Whether used alone or in combination with semi-precious or precious stones, it measures up to the expectations of the designer craftsman.

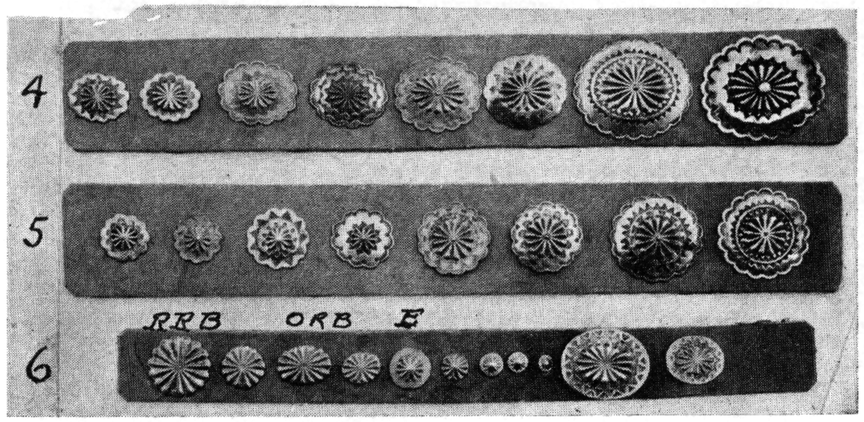
The occurrence of silver ore, widely distributed geographically makes this metal readily accessible to man. Mining cost is nominal. Reduction processes are not complex. A strong demand for the metal now exists despite its present excessive cost. The use of this "precious" metal for craft purposes is limited because silver has an exalted position in the family of monetary metals. Cannot the use of silver as a monetary metal be related to the gold standard, without imposing a price penalty upon its use as a crafts metal?

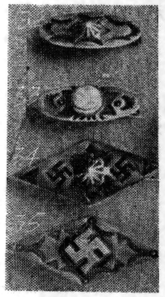
The increased use of silver for craft purposes, which a market value, based on production cost, would stimulate, should go a long way toward sustaining and expanding the silver producing industry. Despite an arbitrary price paid for "newly mined silver" in this silver producing *state, and with a subsidized price as an incentive (the subsidized price is double the market value for scrap silver) the industry is not flourishing, and silver at the newly mined price is prohibitive as a craft metal. Perhaps when these facts are clearly visualized some remedial plan can be devised to relieve the situation with benefit resulting to all concerned.

*Colorado.



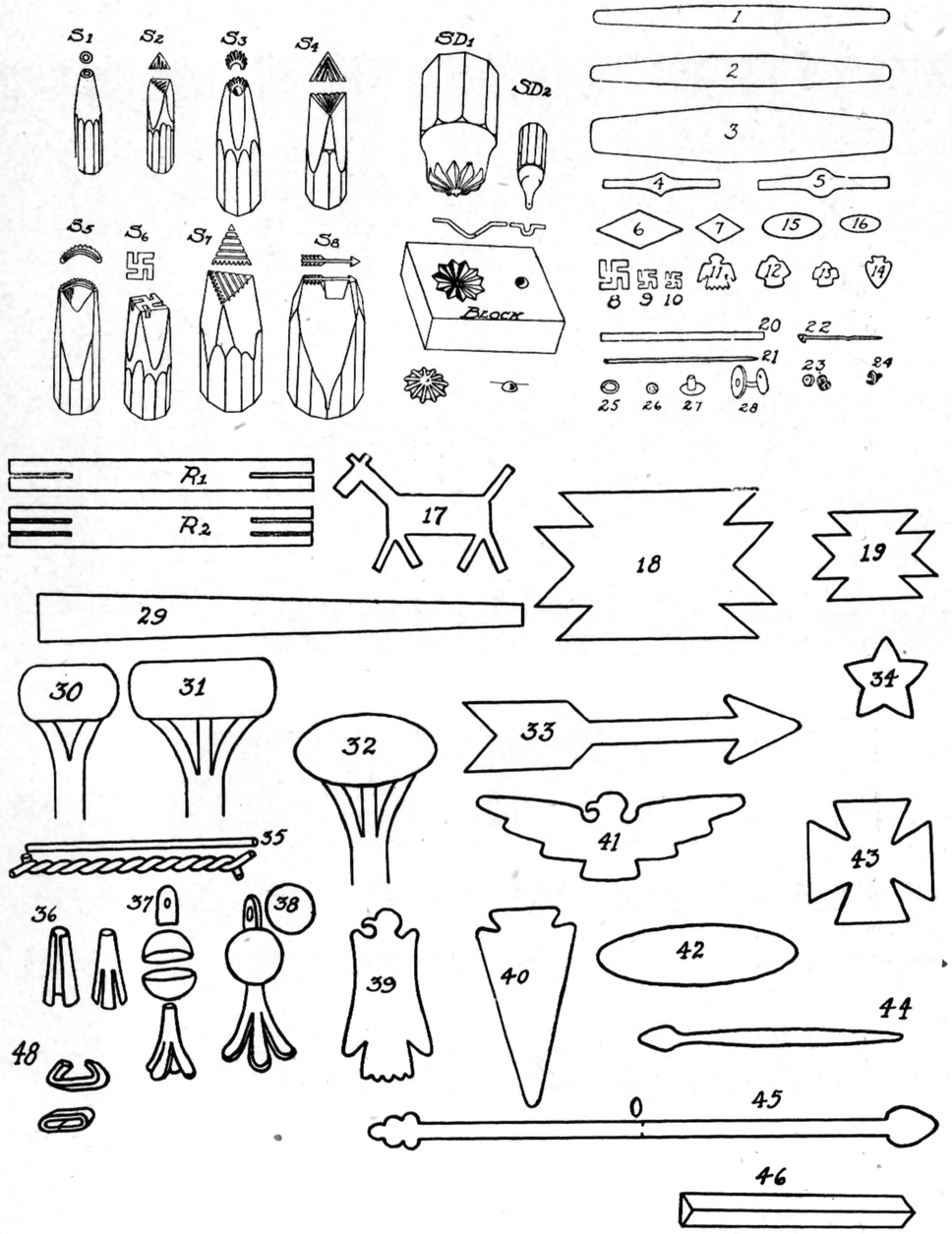






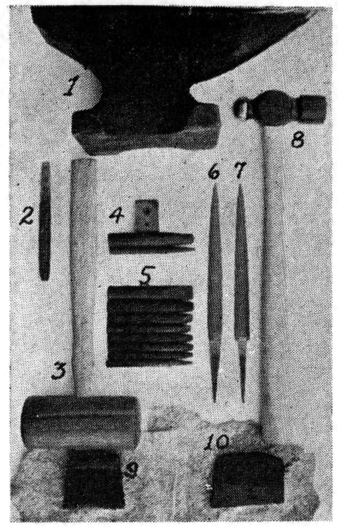
The projects outlined here have been chosen with a regard for the tools and shop facilities needed, according to the degree of skill required, material cost and the time for completion.

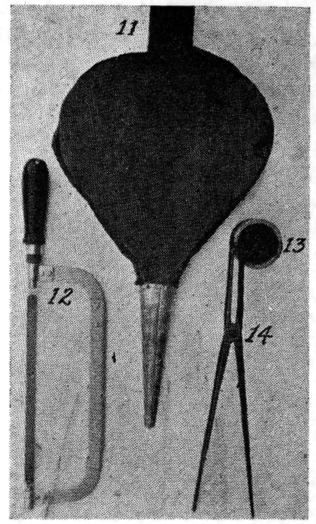
Silver Stamping Tools, Sheared and Cast Shapes

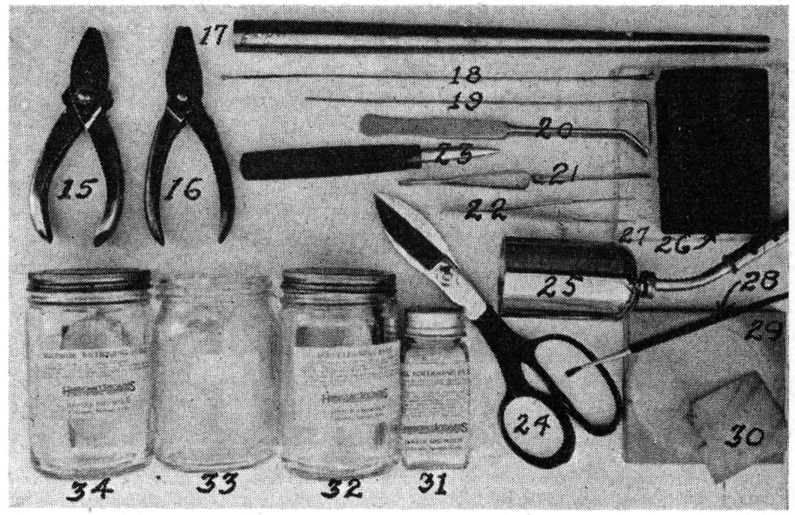


On account of the cost of sterling silver it is desirable to use a base metal for initial experiment until the procedure in working metal is learned, and skill in the use of tools is acquired. Nickel silver is suitable for many articles which are both serviceable and attractive. When sufficient skill is acquired, articles in Sterling may be made, but the nickel silver will usually suffice for the younger group, especially if the expense item must be considered. The above shapes are available in both nickel and sterling silver.

Silver







Tools: Anvil, Cold Chisel, Wooden Mallet, Matrix and Die Block, Stamping Tools, Files—Rough Cut and Smoothing, Ball Pein Hammer, Abrasives, Scratch Remover, Polish, Bellows, Hack Saw, Crucible, Tongs, Pliers—Flat and Round Nose, Ring Mandrel, Soldering Tool, Tweezers, Burnisher, Metal Snips, Torch, Asbestos Block, Charcoal Block, Flux for Soldering, Solder, Borax Slate, 10% Solution Sulphuric Acid for Sterling silver, 100% nitric for Nickel silver, Cleaning Bath, Antiquing Fluid.

METAL WORK
Silver
Useful Tools

The stamping plate shown in Figure 1, Sketch A, is a very useful piece of equipment. Its large flat surface is excellent for applying a stamped decoration. The V cut grooves are useful in holding triangular shaped bracelet blanks while applying a stamped decoration to the beveled surfaces. The stamping plate is mounted in a hardwood block which may be clamped or screwed to a work bench. The block may be fitted with a bench pin, for supporting work while shaping it with a jeweler's saw. The block is also drilled to receive a ring mandrel which may be used as a support for shaping rings and bracelets.

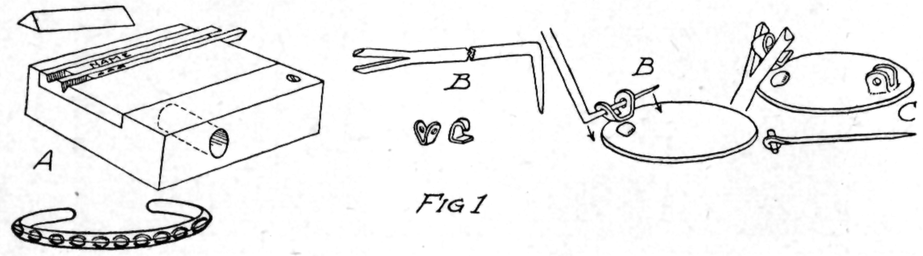


FIG 1

Soldering Probe

This handy tool may be made from a bicycle spoke. One end is tapered and bent at right angles. The other end may be flattened, split, and the prongs spread apart as indicated in Sketch B. Its use in holding hinges and catches while soldering them to a brooch is indicated in the illustration. Its usefulness as a probe to distribute melted solder has been described on page 191.

Stick Shellac or Pitch Block

Frequently both hands are required to handle the setting tool and hammer, during the operation of fitting a bezel around a stone. The Sketches Figure 2 shows a block of hardwood, which may be clamped in a vise, coated with melted stick shellac or engravers pitch. Sketch A shows work being held in the pitch while a bezel is being set, also while a bit of engraving or light carving is being done, Sketch C. The top coating is softened by the heat from a torch. The metal is imbedded in the shellac or pitch, which is pinched up around the edge for additional support. Both of these adhesives become brittle when chilled in cold water and the work may be knocked loose with a wooden mallet.

The Pitch Bowl

The pitch bowl or pan is a necessary support for use in the development of a chased design on metal. A set of chasing tools is indicated in Fig. 2, Sketch A. The use of a tracing tool to outline a design is suggested in Fig. 3.

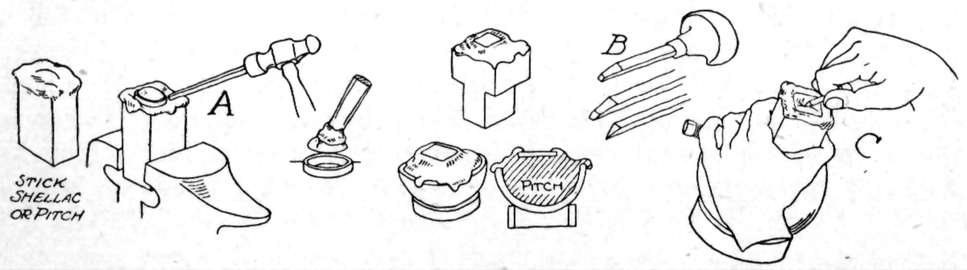


Fig. 2

METAL WORK
Silver

The development of an applied ornament for jewelry decoration is shown in Fig. 3. The outline is traced, edges are beveled, and areas are "raised" by depressing them in the pitch block. The shaped ornament is saw cut from the sheet metal. Edges are filed to correct irregularities in shape, but the ornament is made ready to be attached to an appropriate base by hard solder.

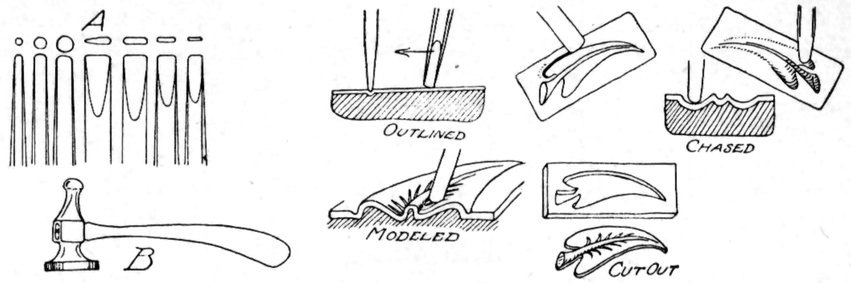


Fig. 3

Wire finds many applications in jewelry making. Structurally its greatest use, perhaps, is in the form of chain. Chain making is not an elaborate process. A knowledge of the technic of wire drawing should be acquired. It will give the designer craftsman greater freedom of expression in his structures.

Frames, of "bent wire fillets", soldered to metal surfaces later to be filled with enamel, form the basic structure for the **Cloisonné** metal work of the Chinese craftsmen.

As a decoration the use of wire in Filigree jewelry is well established. Also twisted wire bezel bands, to encircle mounted stones, have a definite place in the design of craft jewelry. These bands may be made of two strands of round wire of appropriate diameter, twisted together. Another effective bezel band may be made by twisting a single wire of square cross section until the four flat surfaces give a spiral rope effect.

Wire Drawing

Ductility is a property which silver possesses in a high degree. The process of forming wire is one of changing the shape of a given mass of metal.

The original mass may be a casting cylindrical or square in cross section—or for fine wire it may be a strip sheared from sheet metal.

1. Slightly taper and round the end of the cast ingot or sheared strip of sheet metal with a file. This tip must pass through a perforation in a metal plate (known as a draw plate) far enough to be inserted in the jaws of a pair of tongs.

2. **Pull the ingot or strip through the draw plate** as indicated in Fig. 4. The volume of the original metal mass has been forced into an equivalent mass more elongated but reduced in cross section. It has become more rigid and stiff during this process.

3. **Anneal the metal** (coiling the wire insures uniform heating) by placing it on a piece of charcoal and playing the torch flame upon it, until it reaches a cherry red color. The heating restores the ductile quality which suffered loss during the process of elongation while passing through the draw plate.

4. **Repeat these procedures.** Each time passing the end of the wire through a smaller opening in the draw plate. Apply the heat to soften or anneal the strip after each passage through the plate. A bit of bees wax rubbed on the wire will reduce the friction of the wire against the edge of

the draw plate. Draw plates are available graduated in sizes for several standard, round, oval, and special shapes.

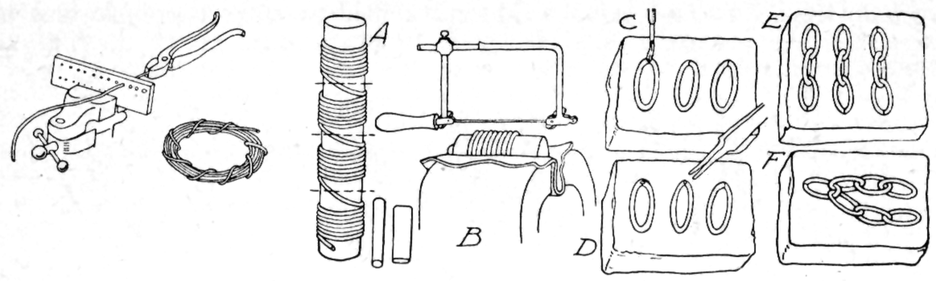


Fig. 4

Chain Making

Wire of specified cross section and size may be fashioned into the desired form selected for the chain link. These links should be identical in form. Their shape is controlled by wrapping the soft wire around a wooden or metal form, known as a mandrel, see Sketch A of Fig. 4.

1. Place a few turns of wire on the mandrel coiled closely together. Separate the next set of turns by a space as indicated in Sketch A. Continue filling mandrel space as required.

2. Place the wire wrapped mandrel in a vise, protected by a piece of leather to preclude marring the metal surface. Saw the loops apart as indicated with a jeweler's saw.

3. Assemble a chain by soldering the first set of links together as indicated in Sketches B-C-D. Pass the open links into the solid links and solder these in turn. The assembly is a progressive operation as indicated by Sketch D.

Hard Soldering

Surfaces to be soldered must be clean. The cleansing process uncovers fresh metal—either by filing, scraping or by the action of an acid bath.

1. **Clean the surface** to be joined by scraping or immersion in an acid bath.

2. **Apply Borax Soldering Flux** with a brush. Use sparingly and coat only the points to be soldered. The solder will flow to all parts of the metal covered with borax. To avoid the solder creeping beyond the joint use the borax only where required.

3. **Place small cuttings of sheet silver solder** in a saucer or borax slate containing water and Borax (20 mule team). Pick up a piece of solder with a pair of soldering tweezers and place it on the joint previously painted with the borax brush. See Sketch B3-B4, Fig. 7, page 195.

4. **Apply heat with the torch gradually** until the borax solution dries. Too rapid application of heat will evaporate the water in the borax solution with violent boiling, and frequently dislodge the solder. In case the piece of solder should "snap off" replace it by a new piece from the borax solution or dip the expelled piece in borax again before replacing it on the joint. This technic avoids a possible contamination of the flux and will insure success in making a soldered joint.

The size and shape of the article to be soldered may influence a choice of method for supporting the work during the soldering operation.

Methods of Supporting Work During the Soldering Operation

A. The work suitably secured with a binding wire may be placed on a charcoal block. Fig. 7, Sketches C1-C2, pages 195. The charcoal is chemically treated to make it slow burning, thus prolonging the life of the block. The torch is played back and forth over the work to drive off the moisture in the flux. Then it is applied directly to the metal. The charcoal will ignite and glow under the work. The residual heat from the charcoal and the direct heat from the torch gradually raises the temperature of the work to the melting point of the solder. When this temperature is reached the solder melts and will flow to all parts of the metal, previously coated with borax. As soon as the solder "flows" the joint should be inspected, to determine whether all points to be soldered have been covered with the liquid solder. If not the temperature of the work should be kept above the melting point of the solder, and while the solder is still fluid it may be distributed over the uncovered parts with the aid of a pointed probe. See sketch of probe made from a bicycle spoke, page 188.

B. Small bands, bezels and finger rings may be soldered by holding them in the flame of a torch with a pair of soldering tweezers or pliers. However, the application of borax and solder as detailed in the instruction (1) to (4), page 190, should be followed. A bezel should be fitted to the stone it is to encircle by first soldering the ends of the bezel strip together. The bezel then should be fitted to the metal which is to support it. This may necessitate filing the bottom of the bezel to suit the contour of the base plate, if the base is curved as in the case with finger rings, Project No. 3. In any event the bottom of the bezel should be filed to make continuous contact with its supporting base. The bezel should be located in its proper position and wired in place with soft iron binding wire. Borax flux should be applied to the inside of the bezel and forced under the band with the brush. Sometimes in tightly fitting bezels it may be necessary to apply the borax brush to the outside, in order to draw the flux under the bezel.

Place pieces of hard solder inside and in contact with the bezel at intervals of about ⅛" to 3/32" apart. See Sketches C1 and C2, page 195.

Apply heat to the bezel placed either on the charcoal block or held in the torch flame with soldering tongs. Stand by with the probe to "personally conduct" any globules of solder to points not covered by the liquid solder. Ordinarily the solder will flow evenly around the entire bezel base the instant it melts. This is the way hard solder should act, flowing to all borax coated areas, when the piece is uniformly heated to a temperature slightly above the *melting point of the solder.

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*Hard solder of different melting points is available. In their assembly, some projects require successive soldering operations. Projects 4 requires three: (1) Bezel band to plate. (2) Plate to prong support. (3) Rain Drop ornaments to plate and prongs, see page 196 Use solder with the **highest melting point first; a lower melting point next** and for the last operation, use solder with the **lowest melting point.**

METAL WORK PROJECTS

Silver

Hammered and Stamped Bracelet, Project No. 1

Tools: Ball Pein Hammer, Anvil, Half Round File, Wooden Mallet, Abrasives, Scratch Remover, Polish, Buckskin, set of Silver Stamping Tools.

Materials: Bracelet Blanks Sheared to Shape.

Instruction:

(1) **Filing.** Round the ends of the bracelet blank by removing the square corners with the file, also round the edges of the blank.

(2) **Decoration. A—Chasing.** Hold the blank firmly on the anvil and strike the surface a light tapping blow with the ball end of the ball pein hammer. See sketch A, Fig. 1. Inspect the surface marking for size depth and shape to determine the proper intensity of the hammer blows required to give a uniform surface appearance. Continue the hammering until the surface is evenly chased. Any uneven or rough edges which the hammering may produce can be trued up with the file.

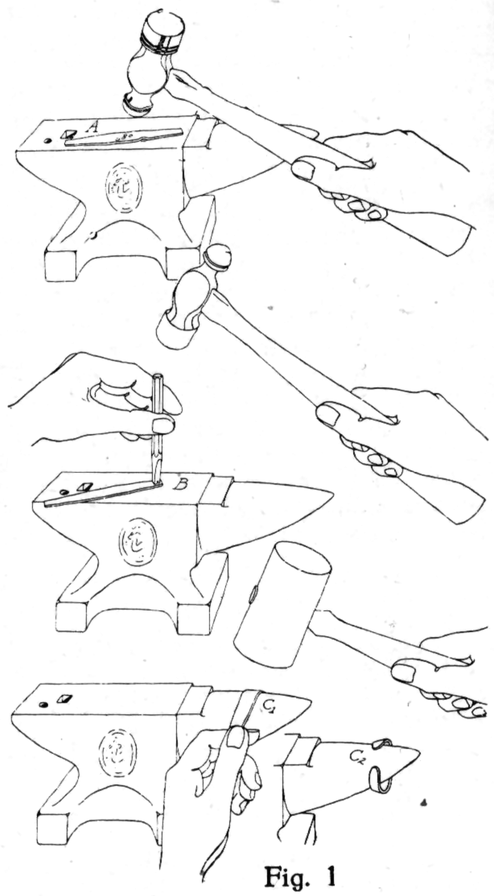


Fig. 1

(2B) **Stamping.** The photograph, page 185, shows a number of designs which may be made with the set of tools shown on page 186. These may be transferred directly to the metal, using carbon paper and a tracing of the design selected, but it is usually sufficient to mark the center line with a pencil, as a guide to the position for the stamped impression.

Place the blank on the anvil, and with the stamping tool held firmly in position and at right angles to the metal, strike it a sharp direct blow with the hammer. See Sketch B, Fig. 1. An indirect or glancing blow will cause the stamp to slip or result in an uneven impression. A little practice will determine the intensity of the blow required, which varies according to the metal used and size of stamp.

(3) **Shaping.** Place the decorated blank on the horn of the anvil, Sketch C, Fig. 1, and bend the ends around the horn by striking them with the wooden mallet, which will not mar the surface. Reverse the bracelet on the horn and straighten up the ends as indicated in Sketch C2.

(4) **Polishing.** Rub the scratch remover well into a piece of buckskin, and apply the charged buckskin to the bracelet. Rub vigorously for a few strokes, then charge another piece of buckskin with the polishing abrasive, and rub gently until the desired finish is secured.

METAL WORK PROJECTS

Silver

Brooch, Project No. 2

Tools: Soldering scraper, Tweezers or Forceps, Charcoal block and Gasoline blow torch, in addition to those listed under projects 1 and 2.

Materials: Any of the shapes Nos. 6, 7, 15 and 16, listed on page 186 also solder, soldering flux, (saturated solution of boric acid) sulphuric acid (10%) solution, and water.

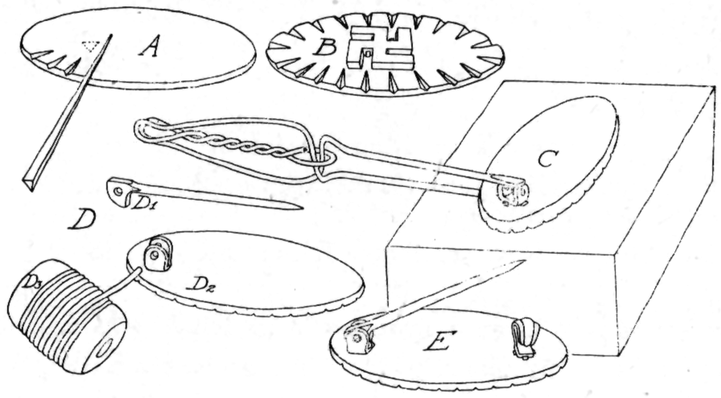
Instruction:

File edges as in projects 1 and 2. The edges may also be filed with a triangular file as in Sketch A, Fig. 3, for decoration.

Apply stamped decoration as under project 1, or solder another shape as Sketch B, Fig. 3, in place, and attach Pin Stem and catch as follows.

Soldering of Pins, Stems and Catches

Sketches E, Fig.2 and C, Fig. 3, indicated two methods of holding the parts to be soldered, the Scarf Pin by a cork and the Brooch hinge joint with tweezers. The soldering operation is illustrated on page 195 under setting turquoise.



Soldering Fig. 3

Scrape the metal bright with a knife blade or scraping tool, B5, Fig. 7, page 195, at the points to be attached. Place Pin or Brooch upon a charcoal block. Moisten the bright surface with the soldering flux, Sketch B6, Fig.7, and place a piece of solder in the flux. Hold the stem, catch or hinge in contact with the solder and direct the flame of the torch on the solder, Sketch C2, Fig. 7, until it melts and flows around the points to be soldered. It will be noted that the solder flows only where the flux has been applied.

When the solder is distributed around the end of the pin stem or catch, remove the heat, and dip the pin or brooch into a jar of 10% sulphuric acid solution, as Sketch D, Fig. 7, to remove the discoloration caused by the heat. As soon as the surface whitens, place in clear water to remove all acid. Polish as in Project 1.

Ring, Project No. 3

Tools: A Ring mandrel and Binding wire in addition to the tools in Projects 1, 2, and 3.

Materials: Shapes Nos. 4 and 5.

Instruction:

(1) **Filing.** File the ends of the ring blank, sketch A, Fig. 4, to present a clear surface for soldering. Remove all sharp edges.

(2) **Decoration.** Stamp or edge file the blank. Attach shape or stone as Sketch B, Fig. 3.

(3) **Shape.** Form the ring over the anvil horn by tapping with the wooden mallet. Bring the ends of the blank together as in Sketch C. Hold the ends in place with a piece of binding wire twisted tightly about the ring. Sketch C. Fig. 4.

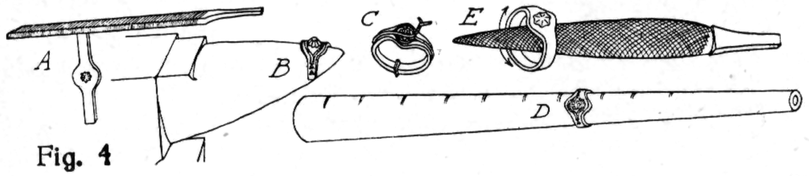


Fig. 4

Solder. Flow flux over the joint, place the piece of solder in the flux, on the inside surface, and holding the ring with the soldering tweezers, melt the solder with the torch flame as in projects 2 and 3. Clean in acid bath and water.

(4) **Shape.** Slip the ring over a mandrel, Sketch D and tap into shape with a wooden mallet.

(5) **Polish.** File any rough edges, Sketch E, and polish as indicated under previous projects.

Prong Type Ring—Project No. 4

Tools: A jeweler's saw, and a knife with a strong blade, in addition to the tools listed for Projects Nos. 1-2-3.

Materials: Strips of Silver or shapes R1 and R2, page 186.

Instruction:

1. Slit the ends of strip as indicated in Sketch A, Fig. 4, with the saw.
2. Spread the prongs apart with a knife blade, see Sketch B.
3. File the prongs to make contact with the bezel plate as indicated in Sketch C.

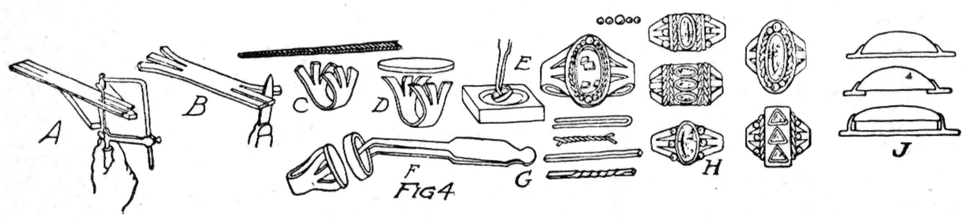


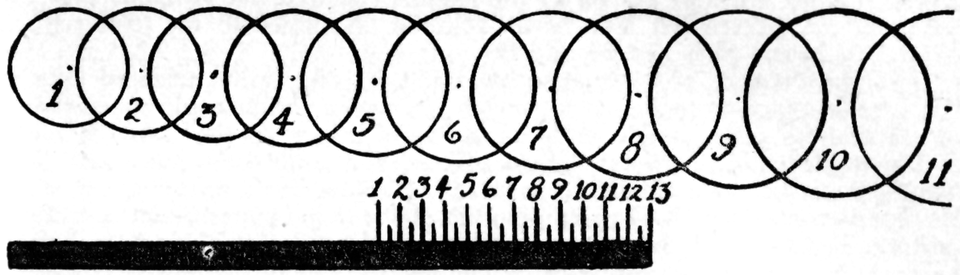
FIG4

4. Solder the bezel to the plate and the plate to the prong support. Sketches D, E and F.

The accompanying sketches suggest styles for finishing prong type rings. Plain Bezel, Twisted Wire Bezel, Rain Drop Ornaments.

Ring Sizes

The diagram of ring sizes will be found useful in ring making. The numbered circles correspond to standard ring sizes. To use the diagram place a finger ring on the circle it will cover. The number in the circle is the ring size. The scale below the diagram shows the length of metal required to make a ring of a given size.



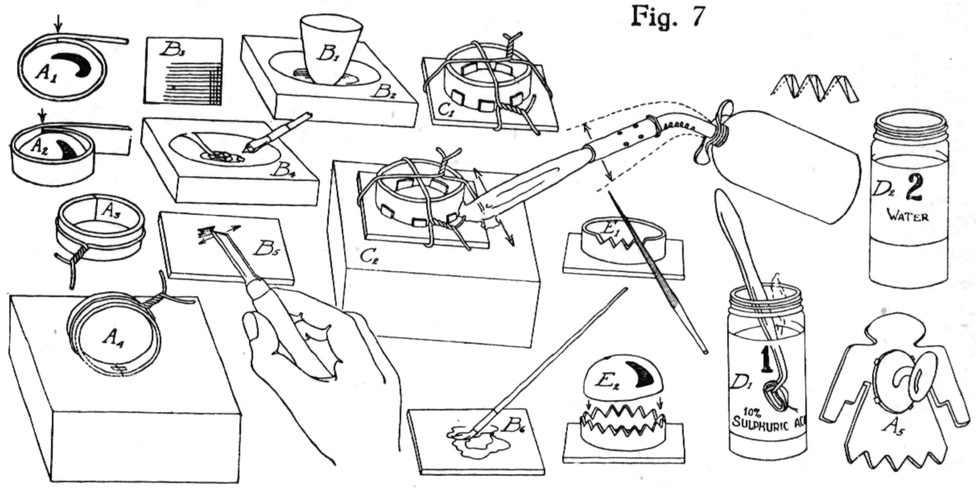
Setting Turquoise

The procedure in setting turquoise involves a soldering operation which is similar to that described in projects 2, 3 and 4.

Tools: Soldering tweezers, Scraper, Binding wire, Hard Solder, Soldering Flux, (saturated solution of boric acid), Brush, Gasoline torch, Charcoal block, Files, Burnisher.

Materials: Thin strips of metal for encircling the turquoise, Ground and Polished Turquoise, Decorated and Shaped Ring and Bracelet blanks, Pin or Brooch.

Fig. 7



Instruction:

(1) **Making the Bezel or Band for Holding the Turquoise.** The strip is bent around the turquoise as shown in Sketches A1 and A2, Fig. 7, and cut to the proper length to just encircle the stone. Scrape the ends bright as previously described, and secure the bezel or band by a piece of binding wire, as shown in Sketch A3. Place on the charcoal block to be soldered, Sketch A4, and apply a drop of soldering flux to the joint. Put a piece of solder in the flux and hold the band with the tweezers in the flame of the blow torch until the solder is melted, and flows across the ends of the band. Remove the wire, clean and polish as described, page 193.

Fit the band to the turquoise, and shape with the fingers and pliers to conform to the outline of the stone. Remove and solder to the finished articles.

(2) **Soldering the Bezel in Place.** The Sketches B1 to 6 show the soldering equipment and its use. B1 is a cone of prepared borax which is dissolved by rubbing in the water held in a piece of slate, Sketch B2. B3 is a sheet of hard solder which has been cut into fine ribbons lengthwise.

These ribbons are then cut off in the lengths required and dropped into the borax water, Sketch B4. The borax solution is applied to the joint with a small hair brush. Sketches B4 and B6.

Scrape the ends of the shaped band and the edge to be soldered, Sketch B5, wire in place as indicated in Sketch C1, apply the flux and place pieces of solder both inside and outside of the band. Place on the charcoal block and heat gradually in the torch flame, Sketch C2, until the solder melts. The heating must be done slowly to prevent the solder from snapping off when the flux becomes dry. A sweeping motion of the flame is desirable to produce uniform heating, and the process will be facilitated if the block is heated before the work is placed upon it. When the solder is flowed smoothly around the junction of the band, remove the torch flame, and the binding wire. Clean in the solution of sulphuric acid and water as described, page 193 and polish.

Mounting the Turquoise. The bezel or band may be left smooth as shown in Sketches A to F, Fig. 8, or notched with a file as shown by Sketches E1 and E2, Fig. 7. Flare the top of the bezel slightly as shown in Sketch A, Fig. 8, using a smooth surfaced burnishing tool or piece of polished metal. Press the turquoise securely in place, Sketches B and C, and bend the top edges into contact with the stone as indicated in Sketches D, E, and F.

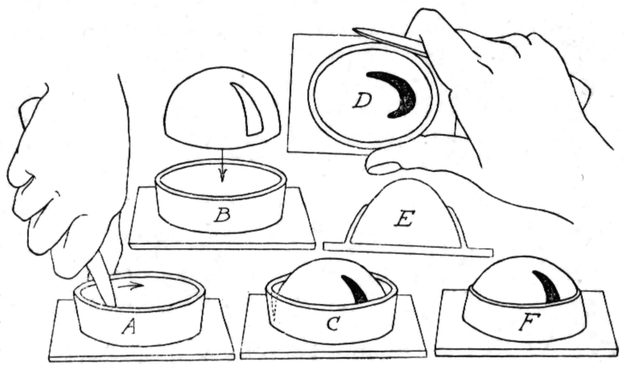


Fig. 8

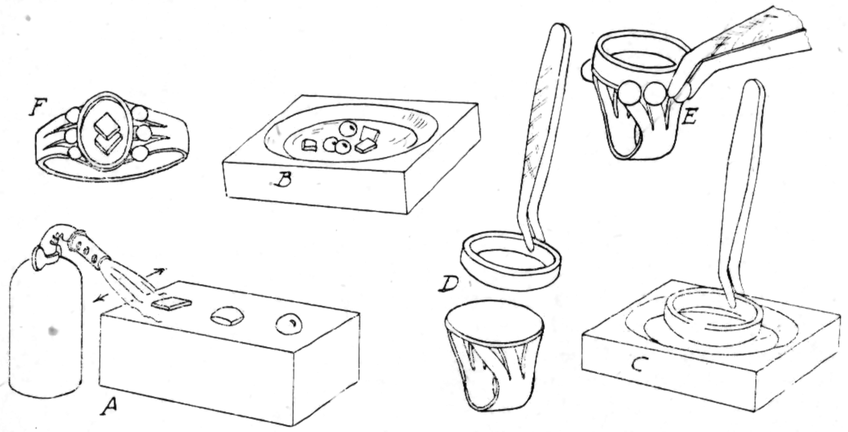


Fig. 9

Making Silver Balls

The miniature silver balls used in native Indian silverwork for the decoration of rings and bracelets are easily made and the process is most fascinating. Place small cuttings of sterling or coin silver on a charcoal block as shown in Sketch A, Fig. 9. Play the flame of a blow torch upon the metal which becomes hed hot, and then as it melts begins to shrink and curl into a spherical mass under the strain of the surface tension. The process is indicated in Sketch A.

Soldering Bezel and Balls to a Ring

Place pieces of solder and the balls in the borax flux shown on the Borax Slate, Sketch B, Fig. 9. Dip the bottom of the bezel in the flux as indicated in Sketch C. Wire the bezel in position, as sketched on page 195. It will be noted that the balls have a flattened area where they come in contact with the charcoal. This surface forms a base for attachment to the metal, Sketch E. Sketch F shows the bezel and six balls in place on the ring. Place a small piece of solder in the center of the bezel and apply heat slowly to first dry the flux which cements the bezel and balls in place. After the flux is dry apply more heat directly upon the bezel and balls until the solder melts and flows to all parts coated with the flux. In this way all six balls and the bezel are soldered at the same time.

Mounting an Arrow Head

Tools: Saw and Glue, also Soldering equipment.
Materials: Arrowhead, Scarf Pin Stem, Piece of Sheet Silver (nickel or sterling).
Instruction:

The flaking of an arrowhead is described in section on Primitive Indian Craft.

(1) Place the arrow head on a piece of paper to determine size of metal required and location of the prongs.

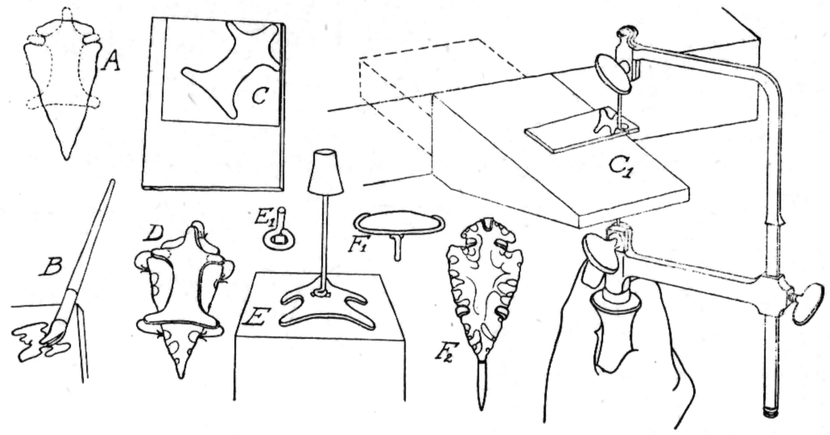


Fig. 5

(2) Sketch shape of mounting as indicated by the dotted lines in Sketch A, Fig. 5. Glue the paper to the piece of metal and (3) hold the metal firmly on a bench block and saw around the outline C and C1.

(4) **Fitting and Soldering.** Place the arrow head on the mounting, Sketch D, and make sure that the prongs are properly located, cup or bend slightly, and then solder the pin stem to the back of the mounting, Sketch E. as described on page 195, Fig. 7.

(5) Attach to the arrowhead by bending the prongs of the mounting over the edges as shown in Sketches F1 and F2.

Making of Shapes used in Silverworking

Strips for mounting turquoise, buckle, tongues, prongs for attaching finished pieces to leather, mountings for arrowheads and the like may be cut from bracelets or other articles which sometimes are spoiled in the making.

Concha Belt—Project No. 5

Tools: Same as listed for Project 1 and 2.

Materials: Any of the semi finished shapes. See illustrations 4-5-6, page 185.

Instruction:

1. Apply a stamped decoration to the edge of the concha, also around the raised center.

2. Attach belt loops of copper or nickel silver as indicated in Fig. 6.

3. Mount on a leather belt strap or make metal connecting links, as indicated in Fig. 6.

4. A suggestion for making a buckle is shown on page 199. Commercial buckle tongues are now available and are superior to tongues made from sheet metal.

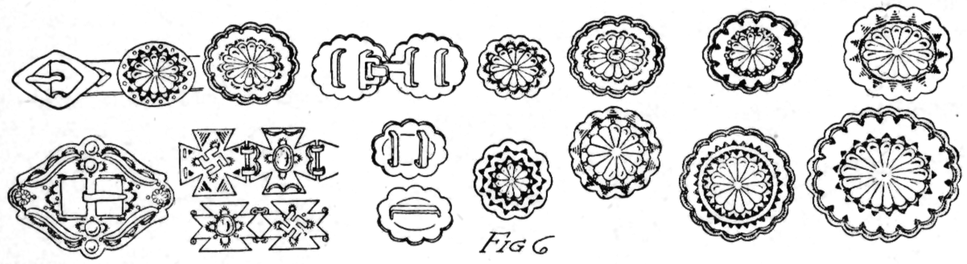


FIG 6

5. File edges to remove irregularities developed during the process of stamping.

6. Polish on a rag buffing wheel or by hand rubbing with buckskin charged with abrasive.

Cutting and Polishing

(1) Mounting the Rough Turquoise on a Polishing Stick. The rough cut stone, having one flat surface and the corners rounded slightly is attached with sealing wax to a stick.

Heat the sealing wax in a candle flame until soft, Sketch A, Fig. 10, press upon the end of a shaped stick, Sketch B. Reheat slightly, Sketch C, and press the stone into the soft wax, Sketch D. Shape the wax around the edges of the stone, Sketch E. Plunge in water to cool or leave in the air.

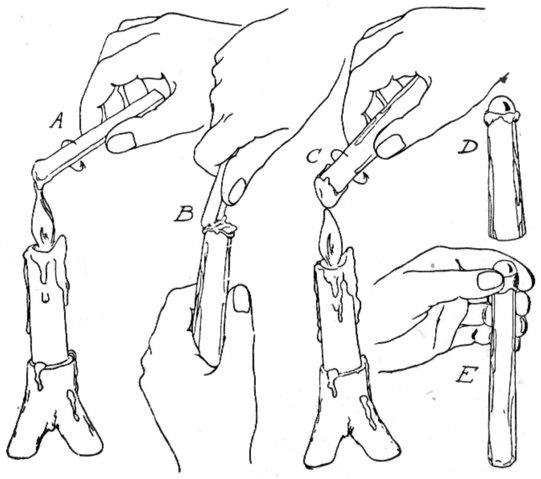


Fig 10

(2) Cutting and Polishing. A piece of rough cut turquoise

may be shaped to approximately the desired outline by rubbing on abrasive paper as shown in Sketch A, Fig. 11, and rub on the abrasive paper, Sketch C, rotating the stick to bring all corners and edges into contact with the paper. Continue the rubbing until the desired shape is obtained. The final polishing, E, is done on a piece of buckskin, D2, on which a polishing abrasive, D1, is rubbed. Sketch E indicates the rotation which gives a good polish.

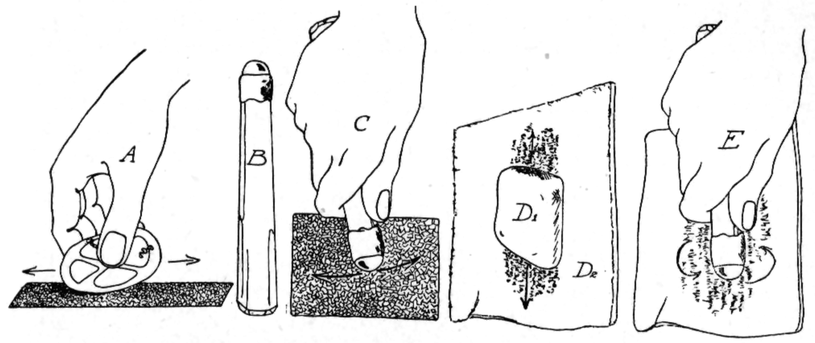
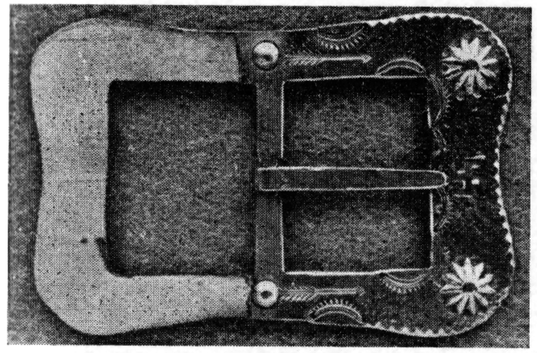
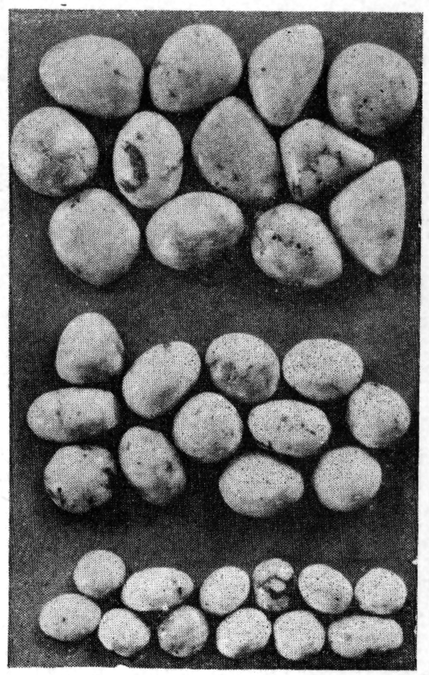


Fig. 11

Polished Turquoise





Buckle

The semi-finished Buckle shown in the photograph is cut from Sheet Nickel Silver with a jeweler's saw. The left half of the Buckle shows the paper on which the shape outline was drawn.

The Stamped and Chased or Hammered Decoration, see page 192, is applied to the surface. The repussed or raised ornaments are made with tools and dies, see page 186. The Rain Drops appear at each end of the tongue bar and the Sun Patterns at the end of the buckle. The edge decoration is made by filing grooves with a small round file. The tongue is made from a piece of metal cut out of the buckle center. Finished buckle tongues are preferable. These are attached by crimping the open end to the tongue bar.

METAL WORK PROJECTS

Silver

Hollow Bead Making

This is a technic used by the Navaho Silversmith. A thin disc of silver of approximate size and shape is placed over a cavity in a die block. The disc is cupped into the shape of the cavity by a hammer driven plunger which forces the metal into the cavity. The round beads shown in Sketches A-B-C, Fig. 7, are made by soldering two hemispheres together. These hemispheres are strung on a wire and soldered together as indicated in Sketches C-D. The oblong beads are soldered together along a vertical axis and must be held in contact with binding wire. See Sketches E to G. These beads make effective necklaces when strung as suggested by Sketches A and B, Fig. 8. The construction detail for the Navaho Squash blossom is indicated in Sketch G. The pendant is the "Nezzah," a cast ornament.

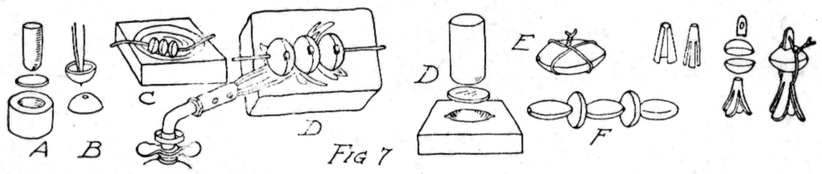


Fig 7

Silver Casting

The "Nezzah" Necklace pendant is made in a stone mold as indicated in Sketches A to C, Fig. 9. The pattern is cut or grooved in the surface of a flat stone. A smooth stone is used for a cover. The gate and vent grooves are shown. The mold and cover plate are held together with wire. The silver may be melted in a pottery crucible placed in a charcoal fire, with air supplied by a hand bellows.

A molding compound "grey investment" used by dentists makes excellent molds for casting silver ornaments. The mold may be sculptured with hand grinding tools or cast around a wax model—see "lost wax" method of mold making described on page 307.

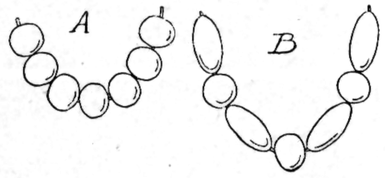


Fig 8

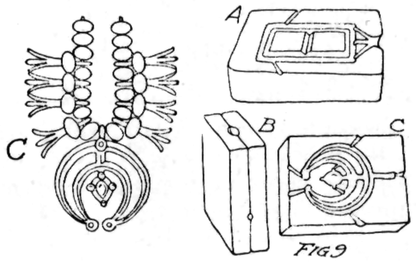
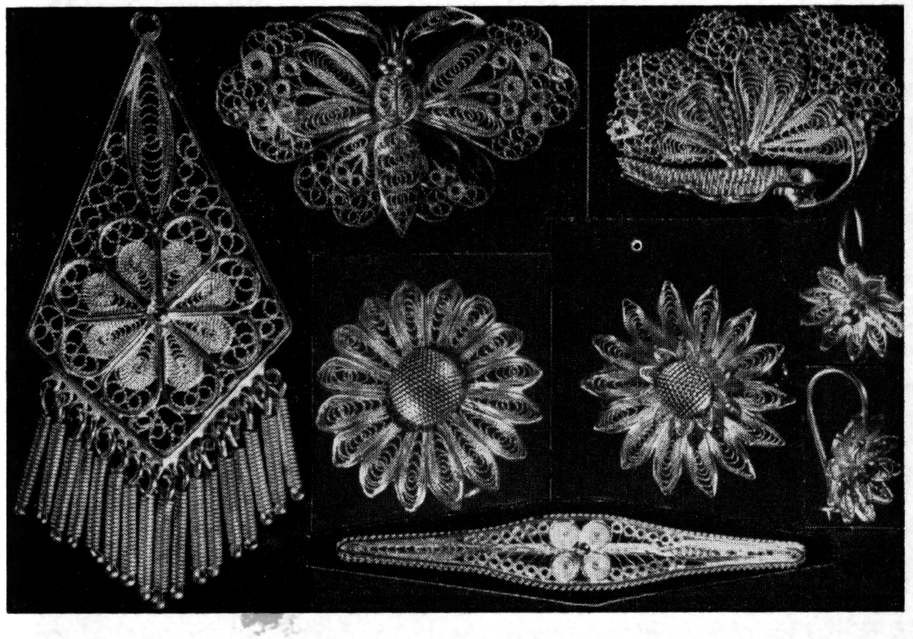


Fig 9

FILIGREE SILVERWORK

In ancient times delicate jewel work with twisted and coiled threads of gold and silver was created by the unexcelled craftsmen of the Greeks, Etruscans and Egyptians for the personal adornment of the nobles. Many museum collections of this filigree work date back to the 6th century B. C. In medieval times the skills of the goldsmiths in filigree work were studied and preserved in the monasteries of Europe and during the Rennaissance many countries revived the craft, including Ireland where a high degree of perfection was reached in the famous Irish filigree work of the 10th and 11th centuries. The native craftsmen of India are said to have preserved designs and methods of filigree work from the most remote times until the present day.

Filigree work in silver was practised by the Moors in Spain during the middle ages with great skill, and from Spain it was carried to the colonies of the new world.



In the middle of the last century many descendants of the Spanish colonists of old Mexico came northward into the Rio Grande Valley of Southwestern Colorado. Among them were silversmiths whose skills have been preserved by successive generations and it was one of these fourth generation craftsmen who proudly demonstrated the technique of filigree work which will be described. Changed times and conditions have lessened the demand for this jewelry, but it is to be hoped that the artistry and precise craftsmanship of the filigree silversmith will be appreciated and adapted to other craftwork projects.

The unit element in filigree work is an area enclosed by a frame made of flattened round wire. The shape of these frames vary with the design employed. The extent to which geometrical shapes in the form of squares, rectangles, ovals, circles are utilized by the filigree worker is shown in the photograph.

The butterfly brooch shows how effective the filigree technique becomes in portraying insect design motifs. The anatomic body structure, head, antenae, eyes, mouth, thorax, wings, legs, feet, abdomen, and both wing and body markings are all realistically and decoratively portrayed. Equally effective are the pieces based on a floral design. Note in the sketches how each area is enclosed by a frame and the variety of patterns utilized to fill in the frame work.

FILIGREE SILVERWORK

My friend Alfredo M. Mondragon is a Spanish American craftsman who works in precious metals. His workshop, "el joyeria de filigrana en plata y oro" is a small room, lighted by a single window and heated with a little wood burning stove, in an adobe ranch house.

His work bench is equipped with jewelers' hand tools. some of which he has cleverly adapted to his particular needs; vise, pliers, wire draw plates, ingot mold, sheet metal wire gauge, files, also the usual soldering materials; borax flux, charcoal block, torch and acid cleaning bath.

The metal which Alfredo uses for his filigree silverwork is Mexican coin silver (pesos), or sterling silver scrap melted in a crucible over a charcoal fire which is enclosed in an adobe lined box. The air supply necessary to raise the temperature of the silver to the melting point is provided by a hand bellows.

His soldering torch, a home made affair, is an ingenious device developed to replace the mouth blown pipe originally used with an alcohol lamp. This torch employs gasoline vapor for its fuel. The principle of forcing air thru a reservoir of white gasoline is not new, and the two common sources for obtaining an air supply are either a foot bellows or a tank of compressed air. Pumping a bellows is a continuous performance and no means for compressing air by power existed at the ranch, so the mechanism illustrated was built.

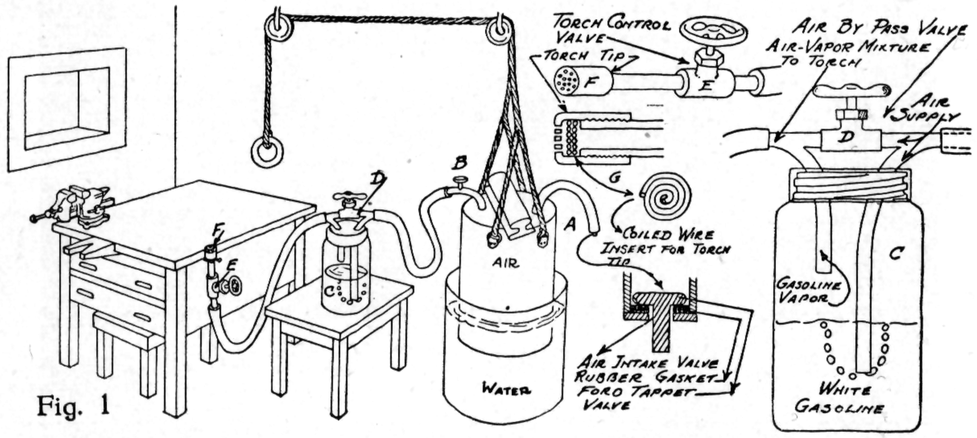


Fig. 1

A sufficiently constant air pressure is developed in an inverted oil barrel, Fig. 3-A, which has the open end water sealed in another slightly larger barrel. The lower barrel is filled approximately two thirds full of water into which the upper barrel is placed as indicated by the sketch. Weights are placed on top of the barrel to produce air compression and maintain a pressure proportionate to the added weight. A very uniform air flow through the gasoline and torch results. The upper barrel descends as the air volume decreases.

The air tank is raised to its highest position by a rope and pulley, and the air drawn inside through a simple intake valve, Sketch A. The air is expelled through the pet cock B, Fig. 1, and bubbles up through the gasoline in the glass jar, Sketch C. The gasoline vapor is mixed with additional air through the pet cock C and the resulting mixture of air and gasoline vapor passes through the hose and pet cock D in the desired quantity to the torch.

The torch is also a simple home made device consisting of a 6" length of ¼" iron pipe, the end of which is covered with a pipe cap. Sketch F shows the detail of the torch tip which reduces the pressure and distributes the gas mixture which is ignited from a match, candle or oil burning pilot light. This style torch gives a large soft flame of sufficient intensity to melt the silver solder. See Sketch G for torch tip detail.

Another interesting device in my friend's tool kit is his container for solder. This is both storage receptacle and a mechanism for distributing fine particles of solder on the work, where required and in the desired quantity. He uses a .45 Colt cartridge shell for a container, the rim of which makes a substantial flat base as indicated in Fig. 2, Sketch A. Just above the rim through a pierced hole is inserted and soldered a small tube for a spout. This spout is about one inch in length and has an inside diameter of approximately 1/16". The end is beveled and several notches are filed on top of the spout as shown in Sketch A. The container is filled with finely filed particles of hard solder (the formula Alfredo uses consists of two parts alarm clock brass and one part fine silver melted together and cast into an ingot), which under vibration pass through the spout and fall on the work. A round stick or metal rod held in contact with the notches on the spout produces the necessary vibration when rubbed back and forth on the spout. A neatly fitting cap slips over the end of the shell to protect the solder from dust and moisture.

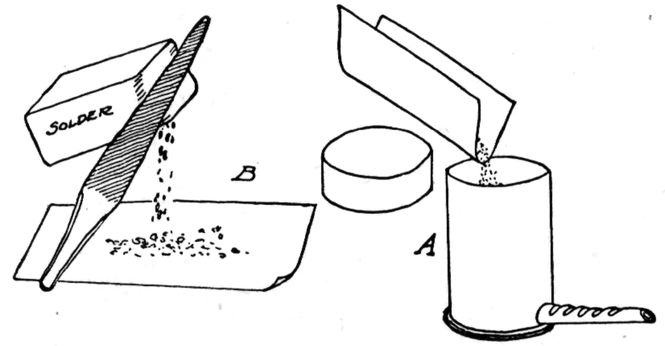


Fig. 2

1. **Layout of Design**

A. Draw to enlarged scale an outline of the project. Sketch in the structural lines needed to provide the required strength and proceed to divide up the space according to the basic elements of the design.

B. Determine position and shape of the twisted wire coils which are to fill each area.

C. Redraw each design element, reduce scale to actual size and cut paper pattern of each area, marking the quantity of each size wanted.

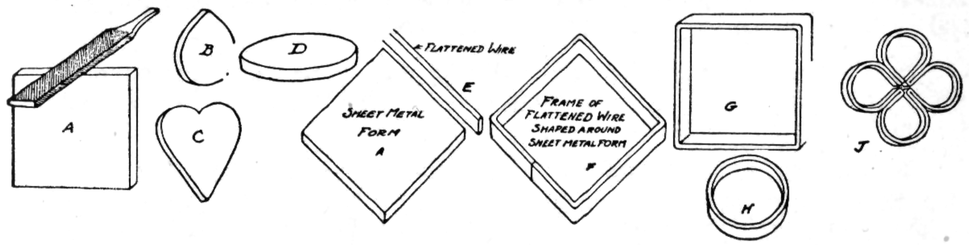


Fig. 3

2. **Make Sheet Metal Forms.**

A. Cement the paper patterns of each design element to 16 gauge sheet metal, nickel, silver, brass, iron, and cut to size and file to shape. See Fig. 3, Sketches A, B, C, D.

3. **Shape Wire Frames Over Sheet Metal Forms.**

The frames used in the filigree jewelry shown in photograph, page 201, are made from round sterling silver wire drawn to 22 gauge, and flattened by rolling to a thickness of 30 gauge.

A. Press the flattened wire against the sheet metal form as shown in Fig. 3, Sketches E, F, G, H, J. Form a butt joint along one side instead of at a corner and solder with hard solder, as described on page 195.

4. **Fill the Frame Areas** with coils of twisted wire according to patterns developed as described under I-B. See Sketch, Fig. 4, F-K-L-M.

A. Use sterling wire, size optional, and draw it to 27 gauge, annealing as required (heat to a dull red in a torch flame, preferably by coiling the strand and placing it on a charcoal block where the flame can be played upon it gently). After each annealing, straighten the coil and prevent kinks by keeping tension on the wire as it is drawn. A 4′ to 5′ length wire is as long as can be conveniently handled.

B. Double the wire and twist together as indicated in Fig. 4, Sketches A to F, until a tight spiral results. The twisting may be done by hand, as indicated in Sketch C. Note that the ends of the wire are held in the jaws of a vise and a small dowel or nail is passed through the loop. Twist the dowel clockwise and at the same time keep sufficient tension on the wire to prevent kinks. When the wire is adequately twisted the spirals resemble a thin strand of rope.

C. Anneal the twisted strand of wire, taking care not to burn or melt the thin strand.

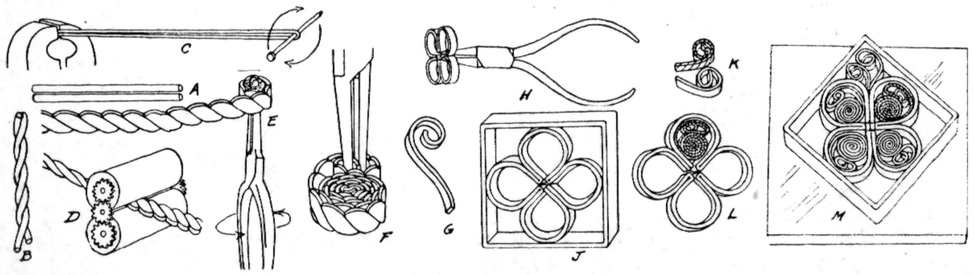


Fig. 4

D. Flatten the twisted strand of 27 gauge wire by passing it through a jeweler's roll as shown in Fig. 4, Sketch D, and reduce the combined thickness to 32 gauge. This will require at least two passages through the roll. Anneal after each time through the roll.

E. Coil the flat strand of twisted wire into spirals of the desired shape, size and number to fill the area enclosed by each frame. See Fig. 4, Sketches L and M for method.

F. Fill the frames with the coiled spirals of wire. Place the frame, Fig. 4, M, on a piece of plate glass. Lift the frame L with pliers and insert it in outer frame as shown in Sketch M. Sketches K-L-M, show the process of setting the coiled wire forms into the spaces within the frames.

5. **Solder the Soils and Frames in Position.**

A. Lift the assembly from the plate glass with a pair of tweezers (if the coils are properly proportioned and placed together within the frame they will be held by tension), and dip it into the flux, a saturated solution of borax, Fig. 5, A. Place on a charcoal block, B.

B. Apply the solder (filings), as described on page 203, and illustrated in Fig. 5, Sketch B, to all points of contact between coils and frame.

C. Apply heat gently to evaporate water in borax by playing the torch on the charcoal block. Gradually raise the temperature of the piece to the

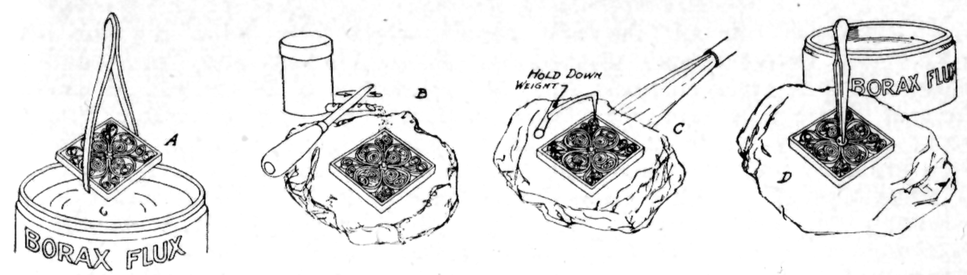


Fig. 5

melting point of the solder which should flow uniformly over the entire frame, Sketch C.

D. Cover the junction of several frames with a ball of sterling soldered in position shown by Fig. 5, Sketch D. See detail for making balls or raindrops given in section on Silversmithing on page 196.

Other styles of coils may be used to fill frames as indicated in Fig. 6, Sketches A to D. Sketch C shows further enrichment of frame with the addition of a loop band, also a pendant ornament. Sketch D shows a decorative treatment for areas enclosed by concentric circular frames.

6. **Assemble Soldered Frames.**

A. Place coil filled frames on the plate glass in the position they are to occupy in the assembly. Inspect for unevenness in thickness and contour. File to uniform thickness when necessary, and true up any edge irregularities.

B. Place adjacent frames in contact, held together by a weight if necessary, Sketch C, Fig. 5, on the charcoal block. Apply flux with a brush, sprinkle fine solder on the joint and bring up the heat gradually until the solder melts.

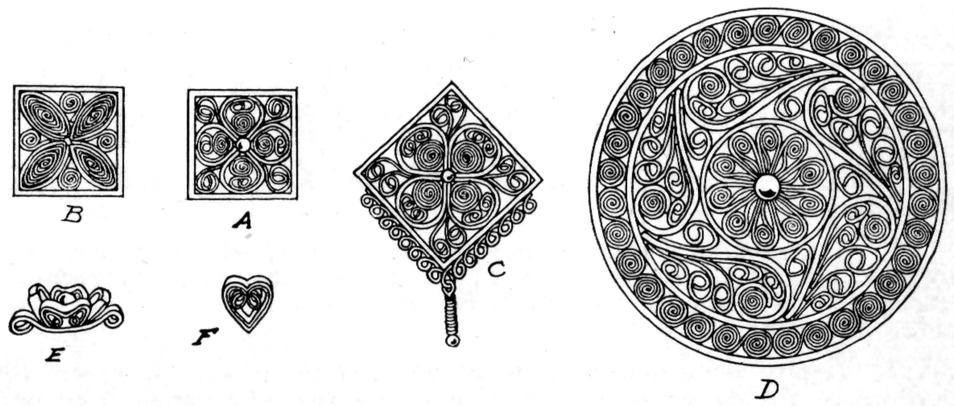


Fig. 6

METAL WORK PROJECTS

Copper

Copper is one of the first metals which man adapted to his use. Apparently native copper washed out of original beds and later found in alluvial soil of river channels was the first source of this metal. A collection of Stone Age relics at Oxford includes an implement made from a piece of copper which had been hammered or pounded into shape, and it was probably known at that time as a soft or malleable stone. Evidence of a knowledge of working copper goes back over 5000 years and skill in adapting it to many purposes was highly developed long before any written records were made. The early Greek historians called this metal of great antiquity **chalkos** because of the proximity of deposits to the town of Chalkos on the Island Eubeoa, and the Romans mention it as **cyprum,** due to its occurrence on the Island of Cyprus. Later this name became the Latin **cuprum** from whence came the derivative **copper.** Biblical reference to brass may refer to the pure copper metal or to bronze, the copper-tin alloy.

On the American continent the use of copper and copper alloys is Pre-Columbian. The Spanish conquerors of Central America found the natives well acquainted with methods of working both copper and bronze, which they used in making the tools employed in the construction of their famous temples. There is evidence that the Mound Builders of North America made implements of copper which they secured from the Lake Superior region, where Jesuit missionaries discovered mines in the sixteenth century. Whether the American Indians worked the copper deposits of this region is not known, but many traces of prehistoric operations were left. The mines of this district have been developed in the past 50 years to the second greatest source of copper in the world, only exceeded by the production of the mines in Chili.

Copper is a very satisfactory craftwork metal. Next to Pewter in workability it may be hammered or drawn into desired shapes. Pewter retains almost constant malleability during the drawing or hammering process. Copper becomes harder under continuous hammering, but may be restored to the original degree of softness by annealing or heating to a red heat and cooling either gradually in the air or by quenching in cold water.

The few projects offered at this time are selected with a view of acquainting beginners with the "feel" of this metal, a craft material which for utility, durability and charm is unexcelled.

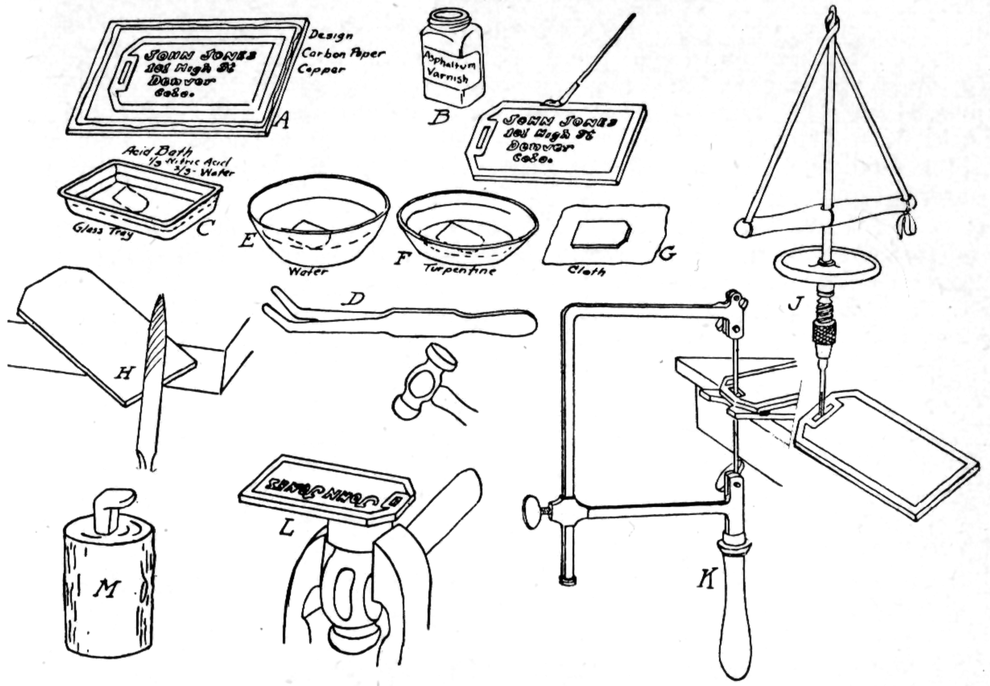
Project No. 1—Identification Tag

Tools: Ball Pein Hammer, a Rough cut and a Smoothing File, Pump Drill and Bit, Jeweler's Saw, Gasoline Torch, Tweezers, Asphaltum Varnish, Turpentine, Etching Acid, Glass or Porcelain Tray. Antiquing Fluids. Abrasives: Emery Cloth No. 00, Scratch Remover, Polish, Banana Oil, Carbon Paper. Brush.

Materials: Copper or Brass, 1¾"x3¼" No. 18 Gauge. Leather strap.
Instruction:

1. Transfer the border design also the name and address to the metal by placing carbon paper, sensitive side against the metal, between the tracing and the metal. See Sketch A, Fig. 1. Retrace the design with a hard pencil or tracing tool.

2. Apply asphaltum varnish to all surfaces of the tag except the portions of the design which are to appear raised and permit it to dry. See Sketch B.



3. Prepare the etching bath (1/3 nitric acid, 2/3 water) and immerse the metal, see Sketch C, using the tweezers so that the solution does not contact the fingers. Gauge the rate of etching by the size and rapidity with which the bubbles rise from the base metal. These will appear in a few minutes if the bath is the correct strength. A little acid should be added if action does not start almost immediately.

Too rapid etching is indicated by the appearance of very large bubbles accompanied by strong fumes, in which case a little water should be added to weaken the solution. Inspect about every 20 minutes to determine the depth of etching. One half to two and a half hours may be required to obtain the desired depth. Remove from the acid bath with the tweezers and rinse in water. See Sketch E.

4. Place the tag in turpentine to soften the asphaltum varnish and remove it with a cloth. See Sketches F and G.

5. Smooth edges and corners with the file. Sketch H. Drill a hole, insert the blade of the jeweler's saw, Sketch J and K, and cut the slot to receive the attachment strap.

6. Stipple the border and center design by hammering lightly with the ball end of the ball pein hammer, using another hammer or a railroad spike as an anvil. Sketches L and M. File smooth any uneven edges produced by hammering.

7. Clean with the emery cloth, scratch remover and polish.

Coloring Copper

A. Color by moving the tag through the blow torch flame until the desired shade appears. The colors change in the order of their appearance, as orange red, bluish purple, brass, dark red, deep purple, iridescent, chestnut brown. Permit the tag to cool, then apply banana oil.

B. Attach leather strap as shown on page 82.

Antiquing Copper

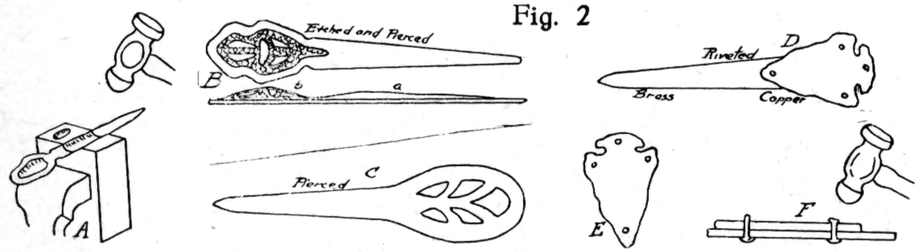
A. Remove any finger prints and undesirable color by placing the tag in an acid cleaning bath (¼ sulphuric acid, ¾ water). **Caution**—When mixing the acid cleaning bath, pour the acid into the water to prevent the acid from flying out of the container which should be glass or porcelain. This strength solution will not injure the hands if they are washed immediately but it will ruin clothing.

B. Apply the antiquing fluid with a brush and permit it to dry. Rub on buckskin charged with polish to brighten the design, leaving the background dark.

C. Apply banana oil and allow to dry.

Project No. 2—Paper Knife

Fig. 2



Tools: As listed under Project No. 1.

Materials: Copper or Brass No. 18 Gauge, 1¼"x6".

Instruction:

Follow process given in steps 1, 2, 3, and 4 of Project No. 1.

5. Smooth up edges and corners with a file.

6. Hammer the design as described in step 6, Project No. 1.

7. Develop a ridge along a center line of the knife blade by forcing the metal into a groove as shown in Fig. 2, Sketch A. Also beat up the design on the handle from the back, by forcing the metal into a depression in a block of wood as indicated in Sketch A. The shape of the finished blade is indicated at points A and B, Sketch B.

8. Clean and finish by coloring or antiquing as described in Project 1. Two other treatments of this project are indicated in Sketch C which shows a pierced design, and Sketch D which shows a piece of copper riveted to a piece of brass. Pierced work is described on page 223 and the detail of riveting is shown in Sketch E, Fig. 2, above.

Project No. 3—Blotter, Rocker Type

Tools: As listed under Project No. 1 with the addition of a block of hardwood size 2"x4" and a hardwood mallet.

Materials: Copper No. 18 Gauge, 2½"x4½": Brass No. 20 Gauge, 2½"x4½". Blotting paper 2½"x4½". **Instruction:**

1. Transfer the design to the metal as described in step 1, Project No. 1. Allow a margin of ¼" to be bent under at each end as indicated in Fig. 3, Sketches A and B. Follow procedure given in steps 2, 3 and 4 of Project No. 1.

5. Bend the ends of the metal over the edge of the block, using a wooden mallet as shown in Sketch C. Continue the bending as in Sketch D and finish as shown in the position E. After the edges are bent into the proper position as indicated by Sketch B, proceed with step 6 while the blotter is on the block.

6. Raise the etched design by hammering the metal into the depression in the block as shown in Sketch F, Fig. 3.

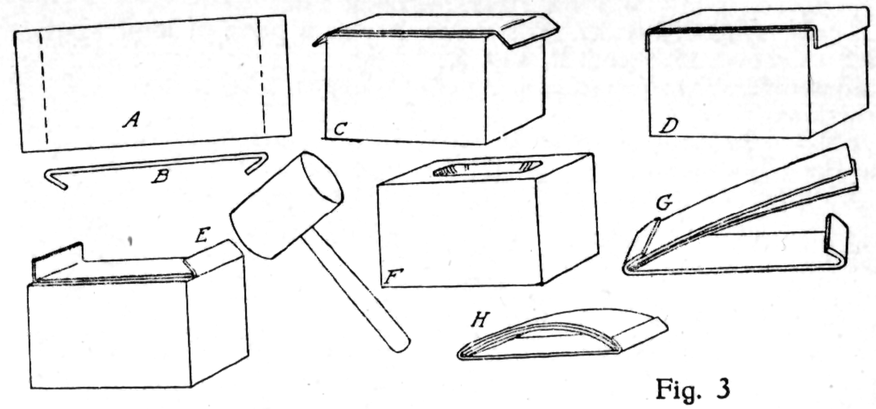


Fig. 3

7. Clean and finish by coloring or antiquing as described under Project No. 1.

8. Insert the blotter and brass as in Sketches G and H, Fig. 3.

Project No. 4—Blotter Corners

Tools: As listed under Project No. 3.

Materials: Four pieces of Copper cut from a piece 5"x10" as indicated by Sketch A, Fig. 4.

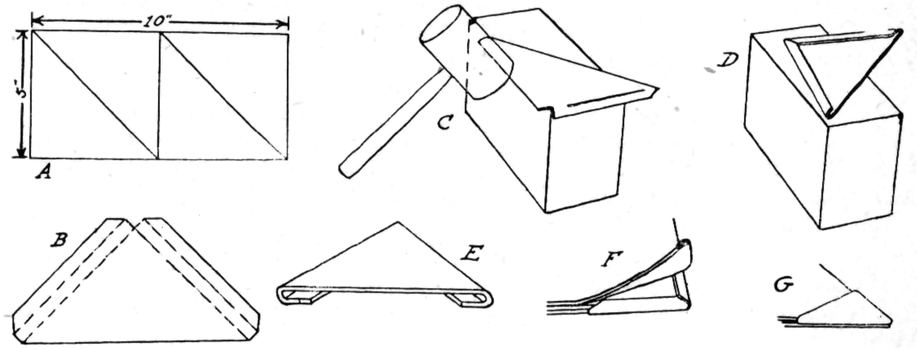


Fig. 4

Instruction:

1. Transfer the design to the metal as in step 1, Project No. 1. Allow a margin of ½" to be rolled under, Sketches B and C. All four pieces indicated in Sketch A, Fig. 4, may be etched at the same time if the size of the etching tray permits.

Follow the process given in steps 2, 3, 4 and 6 of Project No. 1.

7. Raise the design by hammering the metal into the depression in block, Sketch E.

8. Bend the edges along the dotted line, Sketch B, over the corner of the block as shown in Sketch D. Reverse the corner and round the edges as shown in Sketch E.

In case the edges need to be straightened and re-bent, it may be necessary to soften or anneal the metal. Heat it in the torch flame to a red heat and plunge into cold water.

9. Clean and finish by coloring or antiquing as described under Project No. 1.

10. Slip over the blotter pad and crimp into position. Cover the bottom with felt to prevent the metal from scratching the desk top. Sketch F, Fig. 4.

Project No. 5—Book Ends

Tools: As listed under Project No. 3, also a piece of hard wood which is filed as shown in Sketch B, Fig. 5.

Materials: Two pieces of Copper, 18 Gauge, 6″x7″.

Instruction:

Follow the process given in steps 1, 2, 3, and 4, Project No. 1, and make the allowance of ¼″ around the edge for turning under.

5. Place the copper over the shaped block, see Sketch B, Fig. 5, and

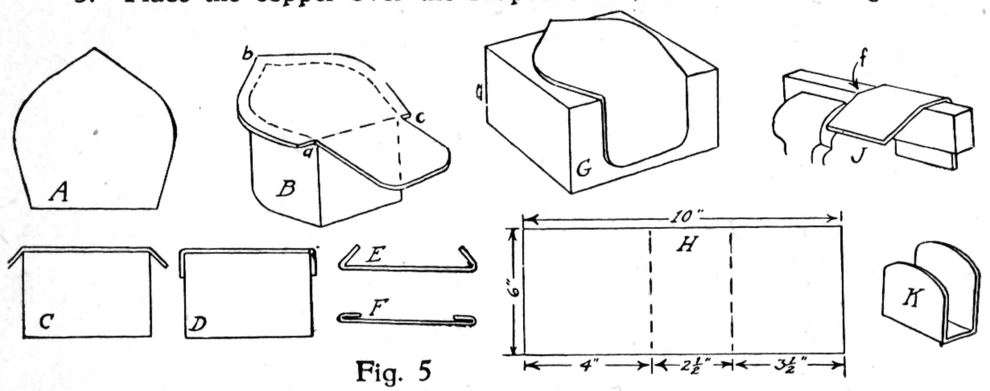


Fig. 5

bend the edges downward between points a, b, c. Sketch C shows the cross section of this process and Sketch D the completion of a right angled bend. Remove from the block, bend into position E, and continue hammering until the edge appears as in Fig. F.

6. Follow step 6 as given for Project No. 1.
7. Raise the design by forcing the metal into a depression in the block.
8. Clean and finish by coloring or antiquing as in Project No. 1.
9. Bend the bottom by placing the copper plate on a table with the lower part extending over the edge, Sketch G, Fig. 5. Start the bending by hand and finish with the wooden mallet.

Project No. 6—Envelope Holder

Tools: As listed under Project No. 1.

Materials: One piece of Copper, 18 Gauge, 6″x10″, Sketch H, Fig. 5.

Instruction:

1. Follow procedure given for Project No. 5, steps 1 to 9.
10. Bend the metal on the line F-F over a board held in a vise as shown in Fig. 5, Sketch J.
11. Clean and finish as in other Projects.

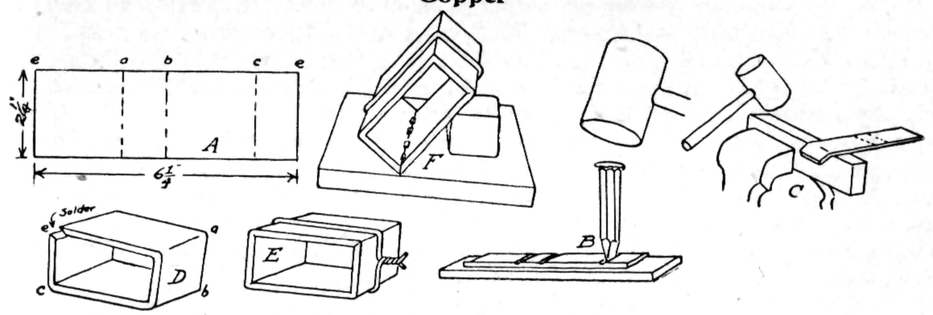
Project No. 7—Napkin Slide

Tools: As listed under Project No. 1 with the addition of a piece of Hardwood, ¾″x2¼″x1″, Hard Solder, Borax and Probe.

Materials: Piece of Copper, 2¼″x6¼″.

Instruction:

1. Transfer the design as described for Project No. 1.
2. Drill, insert saw blade and pierce as described on page 223.
3. File the edges of the design round and smooth.
4. Place the piece of copper on a soft wood board and score the line A-B-C with a blank chisel as shown in Sketch B, Fig. 6. A scoring chisel made from a 16 penny nail is satisfactory.
5. Hammer the edges and design as indicated in step 6, Project 1.
6. Bend on the lines a-b-c, over the corners of the wood block as shown in Sketch C.
7. Solder the ends of the copper strip together at edge C, see Sketch D. The method of hard soldering follows:



a. Scrape the ends of the copper clean with the smoothing file and form a slight bevel or miter as indicated at E.

b. Press the mitered edges together and hold in contact with a piece of iron wire applied as shown in Sketch D.

c. Apply the borax soldering flux to the edges inside of joint C, and place small pieces of fast flowing hard solder in the corner as indicated in Sketch E.

d. Place the slide upon a piece of asbestos or charcoal block and apply the blow torch flame directly to the joint and solder until it is melted.

e. Remove the binding wire and file the joint smooth.

f. Clean in the sulphuric acid bath as described on page 193 under 2.

8. Clean and finish by coloring or antiquing as described under Project No. 1.

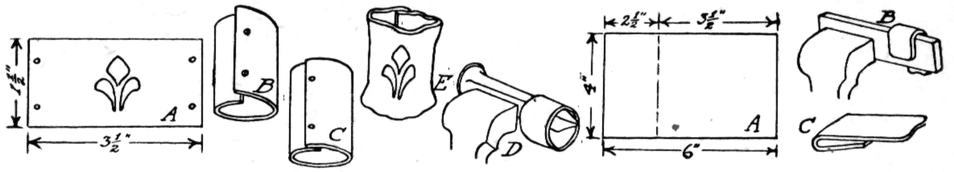
Project No. 8—Napkin Clip

Tools: As listed under Project 1 with the addition of a piece of hard wood shaped on one edge as indicated in Sketch B.

Materials: A piece of copper, 4″x6″.

Instruction:

1. Transfer the design as described for Project No. 1.
2. Drill, insert saw blade and pierce as described on page 223.
3. File the edges of the design round and smooth.
4. Hammer the edges and the design as described in step 6, Project 1.
5. Bend over a shaped stick as shown in Sketch B, Fig. 7.
6. Clean and finish by coloring or antiquing as described under Project No. 1.



Project No. 9—Neckerchief Slide

Tools: Ball Pein Hammer, Railroad Spike and Vice or Anvil. Drill, Jeweler's Saw, Roughing and Smoothing Files.

Materials: One piece of Copper, 18 Gauge, 1½″x3½″, two Copper Rivets.

Instruction:

1. Transfer the design.
2. Pierce or etch as described for Project No. 1.
3. Hammer the edges of the design and file smooth.
4. Drill holes. Bend over bolt or spike, see Sketch D. Rivet as indicated in Sketch C.
5. Give an irregular fluted shape to the tube as shown in Sketch E.
6. Clean and finish as in previous Projects.

Sheet metal in thickness ranging from 5/1000 to 1/100 of an inch, known commercially as 36 and 30 Brown and Sharp gauge is now on the market. This class of metal is classed as foils and being available in Copper, Brass, Aluminum and a new alloy, Oriede Metal or Jeweler's Bronze has made possible an exceedingly popular craft at low cost.

A wide range of skill content is to be found in projects employing this medium. Elementary processes sustain the interest of juvenile groups at several age levels. The design and construction of simple equipment and tools for improving the product of elementary procedure will challenge the imagination and skill of the experienced craftsman to utilize the foils in advanced projects and in combination with other materials.

Procedure in Metal Tooling

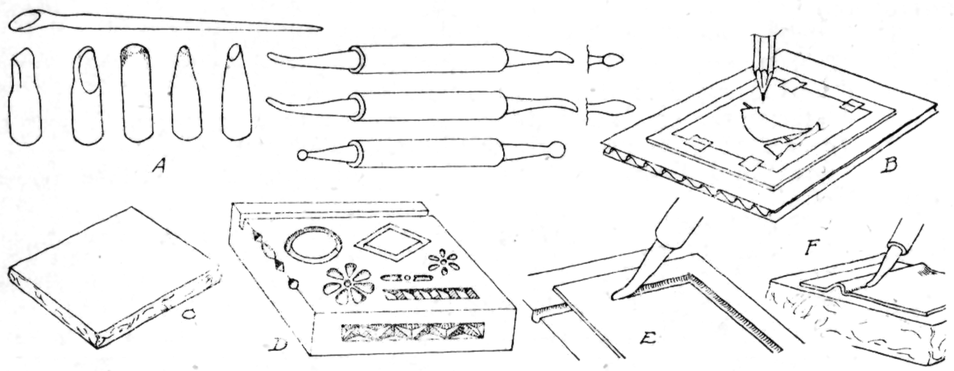
Tools: Wooden Modeling Tools (orange wood manicuring sticks make excellent tools), of any hard wood whittled and sanded into useful shapes as indicated in Sketch A. Leather working tools, tracer-deerfoot, tracer-spoon and ball end modlers are also adequate for the development of designs in metal foils.

A resilient surface, such as corrugated paper, double faced, makes a satisfactory soft base. Sponge rubber, ⅛" thick is also a good base which permits the transfer of a design to thin metals as shown in Sketch B.

A hard surface, plate glass or marble is required in the tooling process to give clear definition to design detail. Sketch C.

Design, printed or traced on strong paper. A metal carbon paper may be used in transferring the design to the metal and is useful on brass and aluminum where a dark outline contrasts with the color of the metal surface. On soft copper foil a 3-H hard lead pencil without carbon paper makes a sufficiently distinct impression.

Scotch Tape or Rubber Cement is required to hold the design sheet on the metal until transferred.



Contour Blocks containing grooves or depressions into which the metal may be pressed with modeling tools will add greatly to the variety of design development and interpretation, especially in the construction of suitable boundaries or borders for design areas. See Sketch D.

Material: 30 to 36 B & S gauge metals—copper, aluminum or jeweler's bronze.

Instruction:

1. Attach the design sheet to the metal with Scotch tape.
2. Trace the design outline with a 3-H hard pencil, or use carbon paper and a tracer tip.
3. Develop the design.

A. Remove the design sheet and retrace the impressed outline with the tracing tip of a metal leather working tool, supporting the metal on a soft surface, corrugated paper or sponge rubber.

B. Mark boundaries of design areas utilizing saw cut grooves, routed area outlines. or chip carved border cuts in the hard wood contour block. See Sketch D. Hold the metal foil in the proper position on the contour block while these incised decorations are located and traced in their proper position.

C. Develop the border outline with the tip of a modeling tool, tracer, deerfoot, spoon or ball end, on the back of the metal placed over the contour block, Sketch E.

D. Place the metal right side up on the marble slab and trace on each side of the raised border line to give clear definition. See detail, Sketch F.

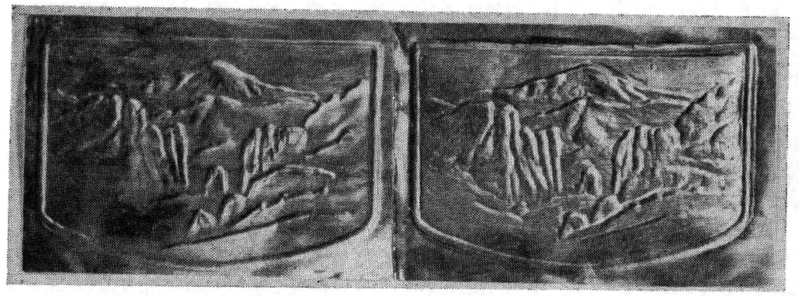
4. Make an Italigio design (depressed below the metal surface).

A. Replace the fail, front or face up, on the contour block over the rosette cavity, and press the metal into the cavity until it contacts all surfaces, using the ball end modeling tool.

C. Place the foil on the hard surface (glass or marble slab), with the back of the metal up, and with a tracer re-define the lines as shown in Sketch F. This will give a clear cut design boundary between the level surfaces and depressed areas as shown in the illustration below.

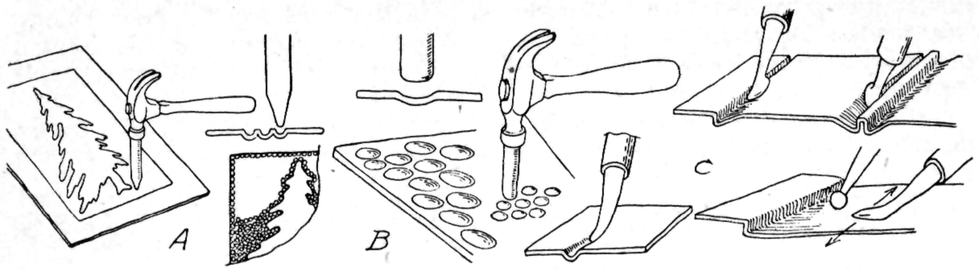
5. **Develop a Bas-Relief Design** (Repusse or raised from the back).

Tool the design areas which are to be raised, first with the metal on the soft resilient surface, then on the hard surface as indicated in Sketches F-G-H. The contour block may be used to stretch the metal which is pressed into a dome with a ball end modeler, or the metal may be gradually shaped by repeated tooling on the soft surface. An example of a bas-relief design is shown in the photograph of the landscape tooled in 36 gauge copper foil. A is metal as tooled in block. B shows lines redefined. The design was tooled with a tracer and ball end modeler. All relief designs should be protected from crushing by a filler applied to the cavities from the back. Plastic wood is excellent for this purpose, or plaster of Paris may be used as detailed in Step 7-C.

A  B

6. **Background Techniques.** The effectiveness of a design is influenced by the character of the background areas. They may be developed in the "flat," that is, in the plane of the metal, depressed below or raised above the plane. Areas adjoining the design are given special treatment to accentuate the design. Rugged contrasts produce boldness and make the design outstanding. Smooth beveled and slightly depressed shadings produce an inconspicuous background, more suitable for certain types of designs.

A. Stippled Background is produced by the process known as **Metal Tapping.** Place the sheet metal on a piece of corrugated cardboard. Apply light hammer blows to a tool with a slightly rounded point and dent, not pierce, the metal along all boundary and design outlines as indicated in Sketch A. Fill in all spaces between borders and design with dents tapped at random in these areas. Re-define the design outline with the tracer tip.



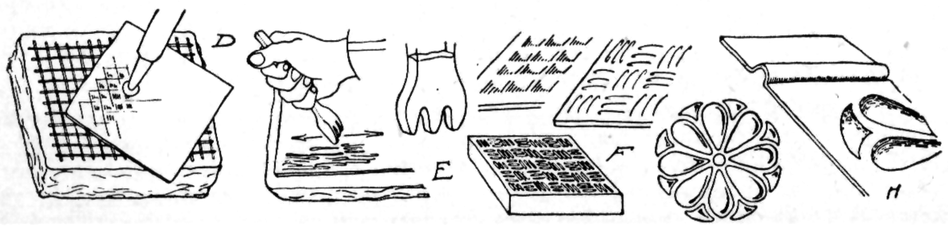
B. **Hammered Background.** Place the metal on a piece of cardboard and apply light hammer blows directly to the metal or to a hard wood dowel which has been rounded slightly, see Sketch B. These impressions should be uniform in depth and resemble the surface of a heavier hammered metal. This type of background may be applied to either the front or the back of the metal foil with equal effectiveness.

C. **Tooled Background.** Place the metal foil on a piece of corrugated cardboard or sponge rubber. Retrace the design and border lines to clearly define the background areas. Develop a bevel, outward from the design outline, with the deer foot modeler as shown in Sketch C. This may produce adequate background, but if a depressed area is desired smooth down the entire background with the ball point and spoon modelers as indicated in Sketch C.

D. **Simulated Wood Grain Background.** Place the metal foil on a soft surface and rub with a wooden creaser, see Sketch D. Experiment with length of stroke and amount of stroke and amount of overlapping to determine the best effect.

E. Another type of effective background is produced by transferring the cross bar of a mesh screen or the effect of a sand paper surface. Place the sheet metal over the screen or sand paper on a hard surface and rub with a blunt metal or wood tool.

The possibilities of this method will suggest many kinds of all-over background designs hachures which may be cut into a linoleum block and then transferred to the sheet metal in the desihred areas.



7. **Color and Finish for Copper and Brass.**

A. **Rub the tooled surface with fine steel wool** and jeweler's rouge.

B. **Heat treatment.** Hold the sheet metal in the flame of an alcohol lamp, or over a bunsen burner or gas bame. Pass it slowly to and fro until the desired color is produced. The range of colors resulting from the application of heat to copper are: orange, red, bluish purple, brassy, dark red, purple, iridescent, brown. Brass also reacts to heat and develops similar colors but in a lesser degree. Apply lacquer as soon as the metal is cold to preserve the color tone and prevent further oxidation.

C. **Oxidation by chemical solution.** Apply with a brush antiquing solution made of potassium sulphate and water (saturated solution), to which is added 6 drops of ammonia per pint of liquid. Highlight by rubbing with a cloth or buckskin charged with tripoli until the desired amount of metal surface is polished for contrast. Then lacquer to preserve this effect.

D. Other colors may be produced by dipping the metal into a hot solution of 300 gr. lead acetate, 600 gr. hyposulphate of soda, 1 quart of water. Colors resulting from this solution range from grey, violet maroon, red, steel blue.

8. **Methods of Mounting Tooled Sheet Metal.**

A. **Attach the tooled sheet metal to a wooden base** with escutcheon pins or nails driven through the metal. Pierce the holes with a drive punch, insert nails and drive part way with a hammer. Use a nail set to finish driving the nail to avoid marring the metal.

B. **Another method** of attaching a piece of tooled metal to a wood base requires that there be sufficient metal margin to permit turning each edge over the base and nailing it.

C. **The picture frame method** of mounting permits the metal to extend to the edge of the wood base or overlap the edge. Hold in place with a few nails driven near the edge. Set the mounted metal into a mitered frame, rabbetted to receive it.

D. **The wedge strip method** of mounting tooled metal may be used. Cut a groove in the wood base at the border of the space which is to be covered with the metal. Insert the edges of the metal and drive a wedge shaped strip of wood into the groove. Secure the wedge with wood glue, hot or cold, applied to the wood surface on the bottom and sides of the groove. A narrow groove may be filled with plastic wood or stick shellac instead of the wedge strip.

E. **Plaster Back Mount.** This method of making a placque has much to recommend its use. Allow $\frac{3}{8}''$ of metal to extend beyond the edge of the finished placque. Bend this edge up at right angles to the back of the metal to form a pan. Into this container place a loop of string or wire and fill it with plaster of Paris. See Pottery Section for method of mixing plaster.

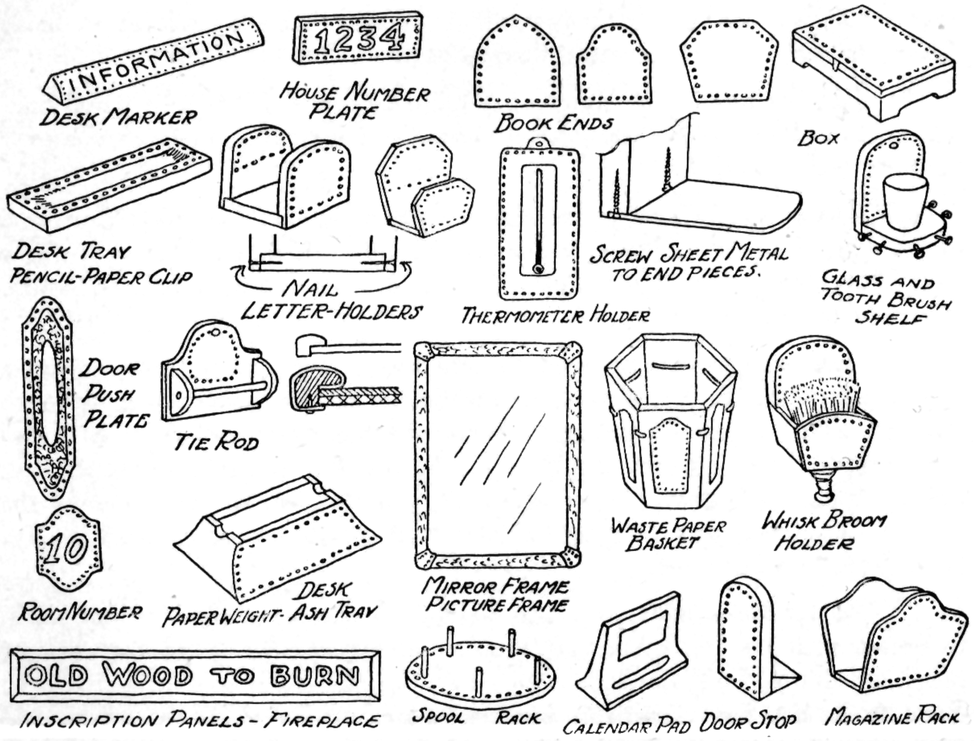
METAL CRAFTWORK

Metal Tooling Projects

Several uses for tooled metal are suggested in the projects illustrated. Tooled metal foil requires adequate backing. Plywood or dimension lumber is a very satisfactory support for sheets of tooled metal, especially since it permits the use of ornamental headed tacks or nails to attach the metal to the wood base. Elementary woodworking construction details, many of which are indicated in the sketches may be used in making appropriate bases for the tooled metal sheets. The wood finish need not be elaborate, any of the standard finishes may be applied. Stain and wax gives a dull finish in a tone complementary to the antiqued and highlighted metal. Shellac, varnish and lacquer also may be appropriately used.

The Book End is a popular project and a sheet metal (18 to 20 gauge) base is recommended. This may be attached with wood screws, as indicated in the Sketch. The screw heads and metal should be covered with a piece of felt or leather. Split cowhide, chamois skin and skiver are suitable leathers.

The waste basket shown is assembled with a wet rawhide thong which creates sufficient tension when dry to hold the basket together. The dry thong should be given a coat of shellac to prevent the penetration of moisture.



PLASTICS

The projects shown are made from Castings of Catlin (phenolic resin) and includes Candle Sticks, Jewel Box, Salt and Pepper Boxes, Humidor, Rosette, Ash Tray and Lamp Base. The Couchant Lion is made from a casting of plexiglas (acrylic resin).

Plastics

During the last decade, many new craft materials have appeared. These products of "creative chemistry" are the **"synthetic resins,"** known in the market as **Plastics.** "Modern Plastics," the *official publication of the new industry classifies the "synthetic resins" according to their chemical nature and physical characteristics.

They include in their list—**Phenolic Resin** ("condensate from phenol-formaldehyde") Urea, Acrylic. Vinyl, Styrene, Alkyd resins.

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*"MODERN PLASTICS CATALOGUE," Breskin Publishing Corporation, 1941 Edition, $3.75. 122 E. 42nd St., New York City.

This is the foremost reference, and authoritative source for information on plastics. Technical Data, Manufacturing Equipment, Products, Sources, Prepared with the cooperation of entire plastics industry.

"Phenolic resins are obtainable by the interaction of many different phenols, aldehydes or keytones, and catalysts. The number of possible combinations which may be employed is almost infinite, which allows the preparation of phenolic resins with properties especially designed for various uses." Compounds which may be cast in molds have specific properties, such as rapid cure, rigid set, smooth high finish and good resistance to heat, electricity, water and solvent." These **compounds are available in powdered or granular form,** and must be placed in hardened tool steel molds under heat and pressure to be formed into their final shape. The temperature may range from 280° F to 350° F while the pressure required is from 2000 lbs. per square inch upward. The chemical reaction or "cure" requires 30 seconds to 10 or 12 minutes depending on the particular class of compound used and the shape and size of the piece.

Phenolic resins, also available in **liquid form** may be cast in "suitable molds of glass, rubber or lead and heated for 48 hours at 78° C." "These castings are fashioned to give the final finished product by one or more standard machining operations ,including sawing or cutting, drilling, threading, forming, carving, embossing, turning, milling, ashing, polishing, etc."

*Catlin (phenolic resin) is the versatile plastic for the craftsman. It is available in castings in the form of sheets, tubes, and rods in a variety of sizes and shapes, in single and multiple color combinations.

Instruction for Working with Catlin

Cutting Operation. Use hand or power saw (band, jig, or circle). The blade should have 14 to 16 teeth per inch, and only enough set to provide clearance. Speed, 8" circle saw—600 r. p. m.

Slicing Cylinders and Rods. Use abrasive wheel (8" wheel, 4500 r. p. m.) and a continuous flow of water.

Roughing to Shape. Use sanding discs and drums, No. 0 Garnet paper for fast cutting, No. 4/0 for final shaping. Operate at the usual speed for wood.

Carving. Use hand files (coarse single cut metal files, shear tooth files). Hand grinders, carving cutters mounted in a lathe spindle or flexible shaft. Multi-tooth cutters are preferable to mounted abrasive points.

Drilling. Use high speed 2800 to 12,000 r. p. m. Back off the drill occasionally to clear flutes and dissipate the heat.

Turning. Use wood or metal working lathe and high speed, tool steel bits. Hold the tool handle higher than the point of tool, to prevent "digging in" and the tip should be about 2° above center.

Finishing. A. Sand with 4/0 to 5/0 garnet paper for first cut. Remove all surface irregularities, tool marks and rough sanding cuts.

B. Follow the initial sanding with 7/0 to 8/0 garnet paper, or wet pumice applied on a felt or leather pad. The pumice may also be used on a muslin wheel, operated in a hood.

C. **Polish** on a muslin or cotton buffing wheel charged with fine abrasive compound. Speed 6" diam buff 2000 to 3000 r. p. m.

Cementing Procedure. Pieces to be joined should be polished to level the surfaces. This surface should be scraped or roughened to remove the glossy finish, before cementing the pieces together.

Tools. Glass plate or dish. Glass stirring rod 1/8" to 3/16", liquid dropper.

Materials. Catlin Cement. Hydrochloric acid (2 parts C. P. acid to 1 part water).

Instruction:

Dip the glass rod into the cement (about ½") and place the liquid on the glass surface, covering an area about 1" in diameter. Place three drops

*Catlin Corporation, 1 Park Ave., New York City.

of acid (use dropper) on the cement and stir vigorously for 30 seconds. If the mixture turns milky white the cement is ready to use. If not add another drop of acid and stir until the right mixture is obtained. Avoid excess acid or the cement will set too quickly. Use the cement within 10 minutes or before it becomes gummy. Apply cement to both pieces to be joined. Clamp together and hold under pressure about 5 hours or more. Excess cement should be removed in 20 to 30 minutes after it has lost its tackiness but while still soft and easily removable. Denatured alcohol will remove cement from hands and tools before it hardens.

Liquid Catalin—Casting Resin

Catalin liquid quick setting Catabond No. 200 CZ casting resin is supplied as a clear yellowish viscous liquid. When mixed with an accelerator it may be poured into suitable molds, where it will harden in a short time, at room temperature. It forms opaque, white solid castings, gradually developing a deep ivory color with age.

Cast objects containing undercuts may be made in rubber molds which cannot be done with the regular slow curing cast phenolic because of the effect of the heat cure upon the rubber. Besides being suitable for casting in different forms of molds, the resin may also be used as a cement for other phenolic plastics as well as wood and other porous material.

Castings made from quick setting resin do not have the permanence or strength possessed by standard Catalin material. However, when the minimum of accelerator is used and the casting is given an oven cure for several hours after removal from the mold, a relatively permanent hard, non-cracking casting can be made.

Preparation of Molds

Molds may be made of Glass, Rubber, Celluloid, Lumarith or any material to which the resin will not adhere in hardening. Plaster of Paris if coated with lacquer to seal the pores may be used.

"Rubber molds which accurately reproduce every detail of an object in the finished casting may be made by covering the object with several coats of liquid prevulcanized latex. The latex is brushed on as fast as a previous coat has dried. Allow 20 minutes to an hour per coat. Ten to twenty coats may be required. The rubber mold should be supported on a rough Plaster of Paris Shell to preserve its shape under the weight of the resin. The plaster when preheated with the mold will retain sufficient heat to accelerate the hardening of the resin.

To aid in stripping the rubber mold from the hardened casting it is advisable to rinse the mold with alcohol or a solution of 1 part glycerine or castor oil in ten parts of alcohol. This should be done immediately before casting so that the rubber surface is still damp when the resin is poured in.

Other important plastics are Casein and other protein, also the *thermoplastic cellulose derivatives.

Celluloid—Cellulose Nitrate. "The most venerable member of the chemical plastics continues to be used in explosives, protective coatings, and plastics." The outstanding properties are: toughness, water resistance, ease of fabrication, and cementing, clarity, colorability and flammability.

Lumarith—Cellulose Acetate. The "second cousin" to celluloid possesses corresponding properties and is non-inflammable. It is manufactured in the form of sheets, rods and tubes.

It may be cemented with the †manufacturer's NX cement.

It may be cut and polished like celluloid on a buffing wheel.

*Thermoplastic, the property of being softened by the application of heat and hardening again on cooling.

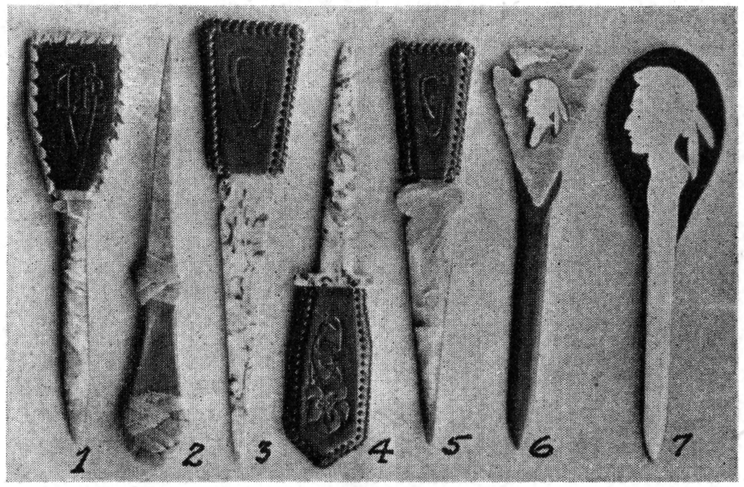
†Celluloid Corporation, 10 East 40th Street, New York City.

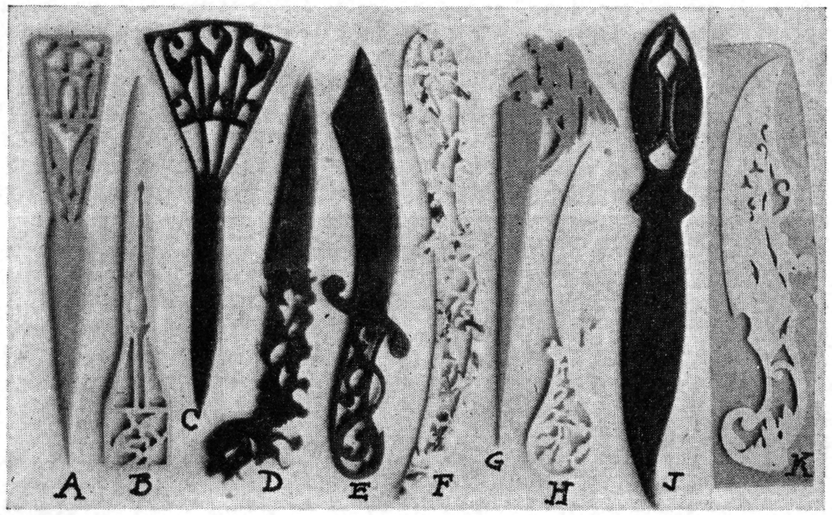
Reference—"Plastics In the School and Home Workshop," A. J. Lockrey, D. Van Nostrand Co., Inc., New York City.

Celluloid

Celluloid, also termed artificial ivory, pyralin and xylonite is a cellulose used extensively, however, until this century, when methods of coloring it were developed. Many natural substances besides ivory may be imitated in celluloid, including tortoise shell, amber, agate, and ebony, and it is available in a wide range of opaque and semi-opaque colors, resembling in marking the finest of marbles and precious stones.

The use of celluloid as a craftwork material has been developed largely since the World war, and many useful and decorative articles may be constructed with inexpensive equipment. It is readily cut with saw, drill, file and edged tools, and can be built up by joining pieces together much in the same way that metal is soldered or welded. It may be bent into desired shapes and offers a fascinating addition to a Handicraft program.



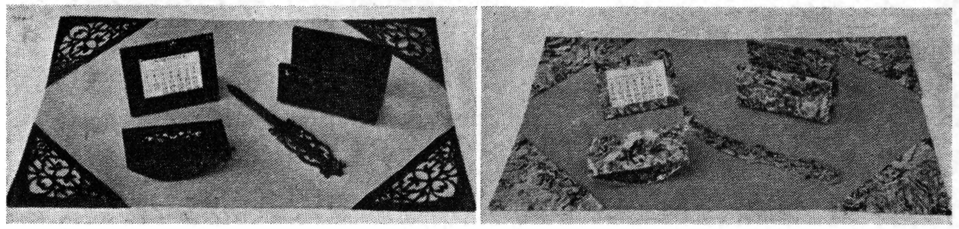


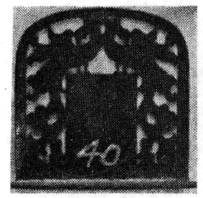
A wide variety of useful and decorative articles may be made from celluloid. The procedure for piercing and sawing is the same for all

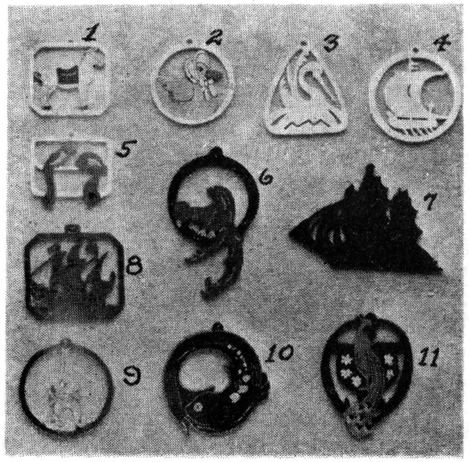
CELLULOID

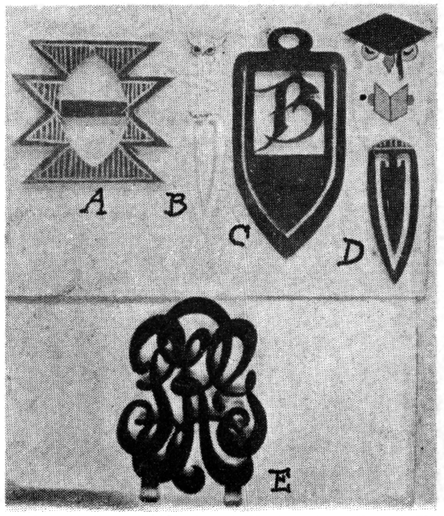
Projects

projects so these are not detailed separately. The illustration below and on page 220 show Paper Knives, Desk Sets, Book Ends, Bridge Table Markers, Book Marks, Neckerchief Slide, Napkin Rings, Shade Pulls, Bag Tops, are shown on page 222.

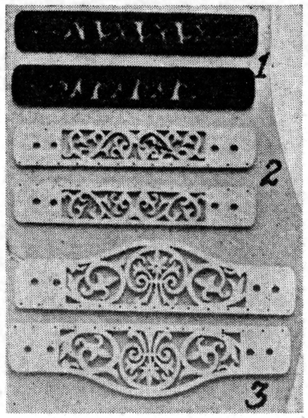


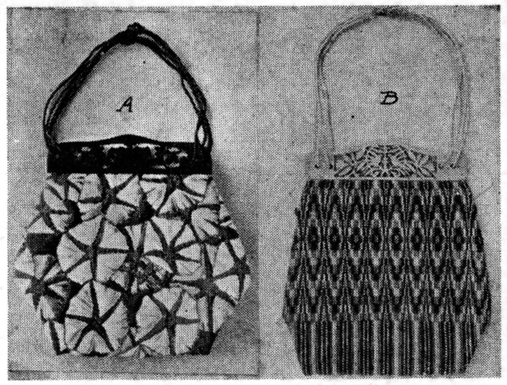


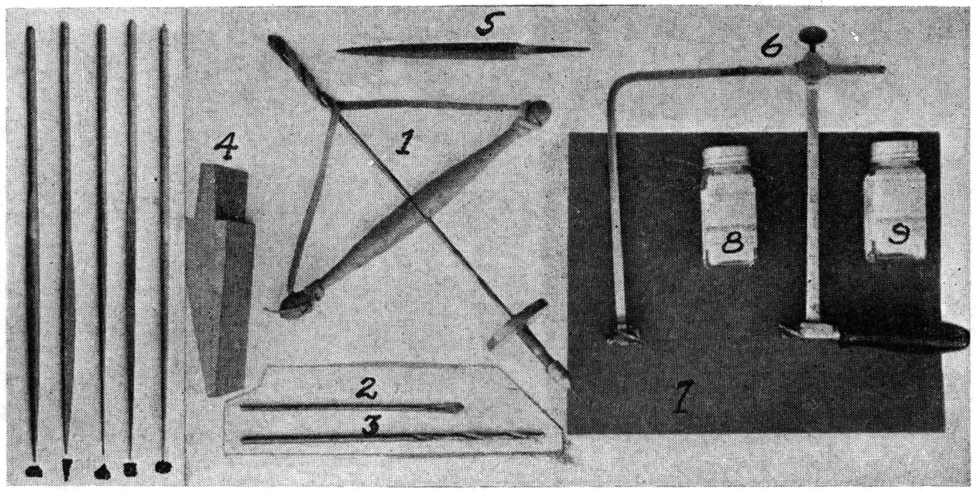




Procedure in Working Celluloid







Tools: Drill—pump or hand type. Drill Bit—pivot or twist drill, size No. 60. Bench Pin. File—6″ half round, No. 1 cut. Jeweler's Saw, 8″. Saw Blades, Nos. 0 and 2. Pumice Powder and a Leather Buff, Sand paper No. 3/0 and 7/0, Flexible Cement, Tracing Paper—Onion Skin or Bond, Celluloid Solvent (Acetone), Brushes, Needle Files—No. 3 cut, Scraper, Bending Clamps, Sensitized Paper—Black and White.

Materials:

Sheet celluloid of different thicknesses or guages, paints, either brushing lacquer in colors, or white lacquer to which oil paint of the desired colors are added. The essential colors from which many shades may be made are: Black, White, Blue (Prussian), Yellow (Chromel), and Red (Vermillion). Lacquer thinner, banana oil, Turpentine and Acetone are also needed.

(1) Remove the glossy finish from the surface of the celluloid by rubbing it with the leather buff, charged with pumice stone. The buff is moistened with water and dry pumice stone sprinkled on the wet surface and stirred to a paste.

(2) Trace the design to be used on the onion skin paper with a No. 3 or 4H pencil sharp enough to make a fine line without cutting the paper. Coat the celluloid lightly with flexible cement, and position the design tracing

Procedure in Working Celluloid

upon the glue coated celluloid, starting along one edge, and rolling the paper into place to prevent wrinkling. Press the design paper smooth, and make sure it is in contact at all points along the design outline.

(3) **Drilling.** Place the celluloid on a board and drill holes with the No. 60 drill bit (page 207. Sketch J, for use of pump drill) in each of the areas to be cut out as indicated in the design tracing. These holes should be at least 1/16″ from any line. Insert the saw blade, teeth pointing downward, in the saw frame and clamp the top thumb screw. The lower end of the saw blade is passed through one of the holes in the celluloid, and then inserted in the lower clamp. See Sketches A to D, Fig. 1.

(4) **Sawing.** Hold the celluloid in position to be cut as shown in Sketch E, Fig. 1, and place the saw as indicated. As the outline is sawed, the celluloid is rotated as shown by arrow, Sketch E, Fig. 1. Use long strokes with light pressure so as not to bend the blade. This will insure

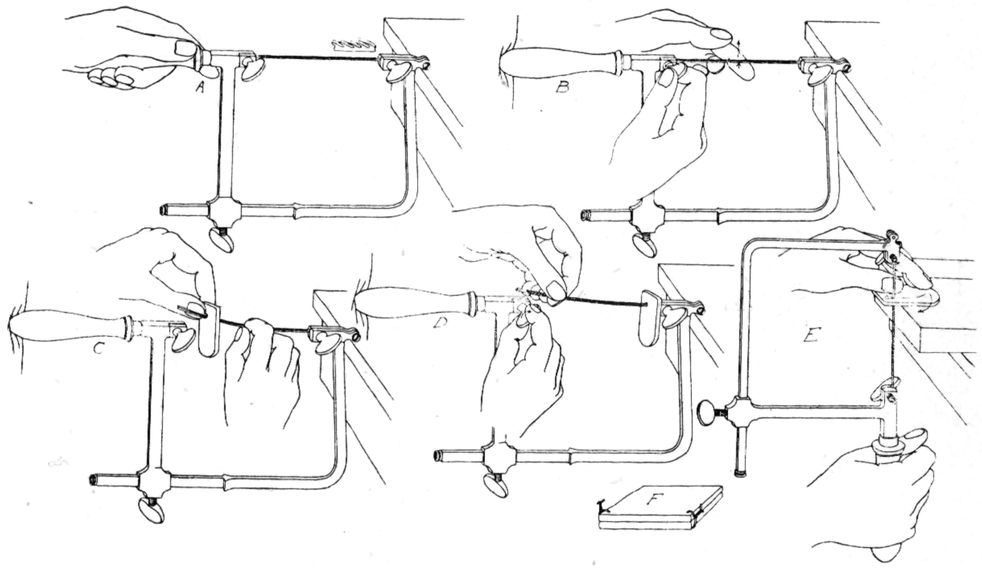


Fig. 1

clean rapid cutting. If the blade is crowded, the friction may induce heat which will soften the celluloid and cause the saw blade to stick and probably break. When the end of a line is reached the saw is withdrawn by working back to the starting hole, keeping the saw moving to prevent binding.

Filing is done to remove saw marks and also true up any irregularities where the saw did not exactly follow the design outline.

(5) **Edge Finishing.** The edges of many articles are rounded by filing or scraping with a sharp knife. A cutting edge is secured on paper knives by beveling the celluloid to the desired thickness.

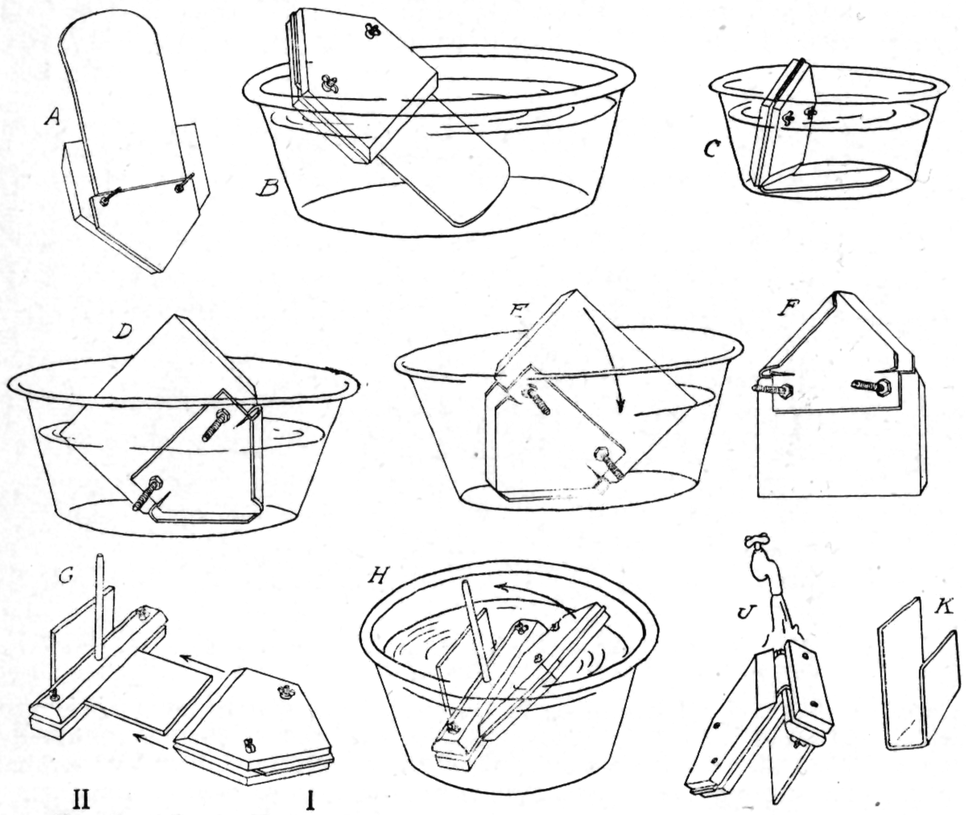
(6) **Surface Finishing.** The under side of the celluloid will be rough along the saw cuts. The edges are smoothed off by rubbing with the 3/0, also the 7/0 sand paper, then with the buff and pumice stone. To keep the rough edges of the celluloid in contact with the buff it may be necessary to hold the celluloid in the hand and push upward as required. Continue the buffing until the surface acquires a soft eggshell finish. Buff both surfaces to obtain an eggshell finish.

Procedure in Working Celluloid

The original glossy finish may be restored by brushing over the surface with acetone, applied with a wide brush or swab. Flow the acetone quickly and evenly over the surface, and permit one application to dry before touching up any areas not evenly glazed. Banana oil may also be used for restoring the surface finish. Caution—Use a clean brush and clean acetone.

(7) **Bending.** Some form of clamping device is used. The two bending clamps shown in Sketches I and II, Fig. 1, are designed for use singly or in combination to make the required bends in the projects described.

Projects which require a single 90 degree bend. as Book Ends, Place Card holders, are held in clamp 1. Sketches A-B-C show the bending process.



Bending Book Ends. The celluloid is set in the clamp as shown in Sketch A with the edge against the metal stop on the lower part of the clamp. The upper half of the clamp is removed. Sketch B shows the upper half of the clamp attached and held by the set screws. The clamp and celluloid is placed in boiling water. As soon as the celluloid softens, pressure on the clamp will force the celluloid against the bottom of the pan and bend it to the desired angle. See Sketch C. Immerse in cold water to chill and set the shape before removing the clamp.

Bending an Envelope Holder. The process of bending an envelope holder is shown in Sketches G, H, J and K. The first bend is made as outlined above for the book end. The bent piece is set in the position shown clamp II, Sketch G. Clamp I is to be attached as indicated. Sketch H shows the piece in the boiling water. Clamp II is pressed firmly against the

Procedure in Working Celluloid

pan while Clamp I is moved into a vertical position. The shaped piece is chilled in cold water and the clamps removed. Sketch K shows the finished piece.

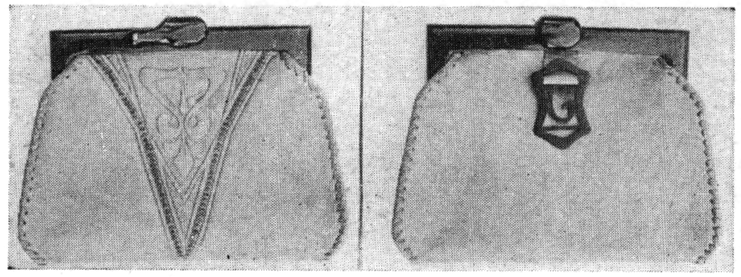
Bending Blotter Corners. The upper part of the bending clamp, No. I, is removed and the celluloid corner is placed beneath the metal plate as shown in Sketch D. Sketch E shows the clamp immersed in boiling water, also the method of folding the celluloid over the edge of the metal by rotating the clamp while exerting pressure against the bottom of the pan.

Sketch F shows one edge of the blotter corner bent over the metal. Repeat the process for the other edge. The top half of the clamp is attached and the turned edges are pressed in between the upper and lower parts of the clamp. The clamp is again placed in boiling water and the softened celluloid is driven snugly over the metal edge and in between the clamps by pressure on the bottom of the pan. Afterwards the clamps are tightened and the blotter corner set by chilling in cold water.

(8) **Painting.** If a painted decoration is to be applied to a celluloid project, the design is transferred to the celluloid by placing sensitized paper (black carbon on light colored and white on dark) under the outline design sheet. The design is then painted on the celluloid after the outline is cut.

The oil colors are mixed with the brushing lacquer and applied with a fine brush. Use No. 0 or No. 1 for lines and No. 8 for area painting. Paint may be removed with a little turpentine on a cloth. Clean brushes with banana oil.

(9) **Uniting Pieces.** The edges to be attached are brushed over with acetone which is a celluloid solvent, and softens by partially dissolving the surface of the celluloid. The coated pieces are pressed quickly together, and held firmly in place until the acetone dries. The surfaces are cemented together so that they will not separate, and the junction is scarcely visible.



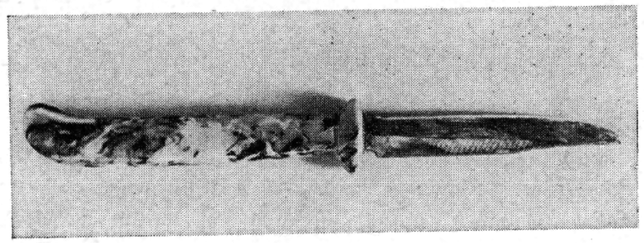
Celluloid Bag Tops, grooved type, are attached with acetone as on the bag illustrated.

The edges of the leather (skived and cemented to the lining) are inserted in the groove of the top and the rivet pins put through to help hold the top in place as the acetone is flowed from a small brush along the edges of the top and into the groove. The slightly dissolved celluloid penetrates the leather and cements it to the top as the acetone dries. After the top is entirely dry the pins are cut off and riveted.

The Bag Tops, page 222, are suitable for the tops of fabric bags, and are also appropriate with suede leather, painted, tooled and other decorated leather bags. These tops are attached by sewing through holes perforated when the design is sawed. The tops are sawed in pairs, the two pieces of celluloid being held in place by wires.

Handle for a Knife

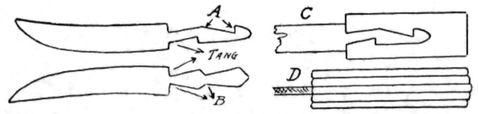
Celluloid makes excellent handles for knife blades. Blades of copper constructed as described in the chapter on Metal work, page 208, combine beautifully with Celluloid to make paper knives. Wooden and Bone handles which have become loosened or broken may be replaced with Celluloid and if desired a complete knife may be made, using an old file for the blade.



A mess kit or camp knife may be ground from a file to the desired shape on an emery wheel, finished with emery cloth and polished with the abrasives used in silver work, page 192. Celluloid handles are fitted in the following manner.

Instruction:

1. The tang of the knife should be notched or dove tailed as indicated in Sketches A and B, Fig. 1.



2. Make an outline of the tang on a piece of paper and cement it on a piece of celluloid. Remove the tang shaped piece of celluloid by saw cutting along the outline.

3. Fit the tang into the piece of celluloid. Coat both sides of the piece with acetone and join a piece of celluloid to each side. In this way build up each side to the desired thickness by adding layers of celluloid.

4. File the handle to the desired shape and smooth with sand paper. Finish with pumice stone or the buckskin and polish.

Neckerchief Slides . A, page 221, is one of a wide variety possible for Camp craft, using small remnant pieces. Camp symbols, numerals and other designs may be used and the elements of the work mastered in making this simple project.

Engraved Decoration

The surface of celluloid is readily cut by engraving tools, but the art of engraving requires considerable skill. Initials and Monograms may be appropriately used in decorating many celluloid projects, and effective color combinations may be secured by rubbing monogram filler into the engraved lines. See page 368 for use of the monogram filler in a neckerchief slide. Instructions for engraving simple line designs and motifs are given under decoration of horn, page 368.

The alphabets and monograms shown in Plates 1, 2, 3, and 4, page 227, are engraved on celluloid and afterwards filled with a colored wax preparation known as monogram filler. The tool used is a V point Graver, Sketch

G, Fig. 4, page 447, and the manner of using it is also shown. The graver is held in the hand as indicated in Sketches J1 and J2. The thumb is placed on the surface to be engraved in the position shown and serves both as a cushion and a guide while making the cutting stroke described below.

The graver handle rests in the palm of the hand and is propelled and repelled. The thumb is held firmly in contact with the work at all times. Straight lines are made with a steady pressure stroke of the hand while the graver slides across the end of the thumb. Curved lines are made in a similar way, while the hand is rotated about the thumb tip as a pivot point. The Sketch E shows a project (cutting of parallel lines of uniform width and depth) designed to develop skill needed in making the upright lines or stems of letters. Sketch F shows another project (cutting of curved lines) to develop skill in shading, needed in forming the lobes of the round letters P and R and the tail or swash line on R. plate 1.

Two kinds of cuts besides the straight stem lines are used in forming the letters in the italic script shown in the alphabet, Plate 1. Both are shown in the formation of the letter M, Plate 1. The cuts shown on the flat

bottomed stem are made by a stabbing action which carries the graver tip into the celluloid to a depth which defines the width of the stem when the tip is elevated. A small pyramid of celluloid is removed when the tip of the graver is lifted out of the celluloid.

A second cut is shown on the last stem of the M, Plate 1. The cut is started about two-thirds the height of the stem and is made by a sweeping

outward motion of the hand. The plate should be easily rotated so that the continuation of the descending stroke becomes an ascending stroke in producing the stub of the letter.

The letter R shows how the finishing touch or stroke is made on the top and bottom of the stem which forms the stub or serfs. The round corner or lobe is made by rotating the work as the curved stroke is made. The tail of the R or swash line is made in a manner similar to that described in making the last stem of the M.

The top of the Fig. 5, Plate 1, is made by two short strokes as indicated. One starts at the lower right hand corner and is terminated on the stem line. The other begins in the upper left hand corner at the stem line and terminates in a line paralleling the stem and at the point of the first cut in the right hand corner.

Plate 2 shows a block letter alphabet cut with the same style graving tool. The effect shown in the initial A is produced by heavy and light shade lines. The serrated border shown in the initial G is produced by the stroke used in forming the bottom of the letter M, Plate 1. The initial R shows a shaded letter enclosed in a panel with stippled background. The stippled effect is produced by lifting out small pyramid shaped chips of celluloid with the tip of the graver. The shaded initials E, K, N, also enclosed in a panel are given prominence by the diagonal line background.

Plates 3 and 4 show other treatments for initials and monograms. The initials E, S, V, Plate 4, are surfaced with light engraved lines bounding areas irregular in size and shape. This gives a flake like or crackled appearance. The partial shading with diagonal lines as shown in the initials B and M produces an interesting surface treatment. The dots used in the initials B, Plate 4, also in stem terminal, Plate 1, see letters A, N, J and K, are made by holding the graver point firmly imbedded in the celluloid while the piece is rotated. The rotation causes the graver point to remove a small cone shaped piece of celluloid.

Celluloid Etching

The decoration of celluloid by means of grooves cut with the engraver's tools and filled with a colored wax compound has been described in the foregoing paragraph. Design prints on paper or fabric may be made from transparent celluloid which has been similarly cut with appropriate tools. The grooves are filled with ink which is then impressed upon the paper in much the same way that etchings are made from copper plates.

In the preparation of copper plates the old masters grooved or etched the metal by means of acid applied through channels made in a protective covering of acid resisting wax, or they incised the design with engraving tools directly upon the metal. This is termed dry point etching and is the method used in making plates from celluloid which may be incised along the outline of a pen and ink drawing or other subject placed underneath it. This is a much simpler process than the cutting of a design drawn or traced upon an opaque metal as must be done in the making of copper plates.

Etching Celluloid Plates

Tools: A Scraper and an Incising Tool or Graver, which may be made as described under instruction. Small Drawing board and thumb tacks. Prepared chalk and No. 00 Sand paper.

Material: Transparent celluloid 20 to 40/1000 gauge.

Instruction:

An incising tool or graver may be readily made from a crochet needle or from a bicycle spoke. See Fig. 2, Sketch A, B, C, page 229. Anneal or soften the end of the needle or spoke by heating it to a bright red and allowing it to cool slowly. Then bend the tip at right angles, Sketch B and

bevel the end to a triangular point on a coarse emery stone or grinder, Sketch B and C. Finish the edge on a fine stone. Temper or harden the tool by reheating to a bright red and cool quickly by plunging it into cold water.

The scraper may be made from a flat file ground to the shape indicated and sharpened on both sides of the blade. See Sketches D, E, and F.

1. Place the drawing or design tracing upon a piece of blotting paper, cover with the celluloid and attach to the drawing board, Sketch G. It is desirable to test the tools and practice the cutting operation on a scrap piece of celluloid before undertaking the graving of the plate. Control of position and movement should be developed and the required degree of pressure for heavy and fine lines determined.

2. Incise the design outline with the graving tool, removing a small shaving of celluloid as indicated. Sketch J shows the correct position of the graving tool and the direction of motion. A clean cut groove should be produced. Sharpen the graver frequently on a fine oil stone or razor hone. Turn the board as required to obtain the proper position for cutting all lines with a pulled or drawn stroke of the incising tools which must be kept vertical at all times. Inspect the grooves for width and depth. This is facilitated by rubbing engraver's chalk (Magnesia) into them so that the exact depth and margins are clearly shown as in the finished print.

3. **Background.** Work up the background to produce the effect of sky, clouds, foliage, high lights and shadows with the scraper. Hold the tool as shown in Sketch K with the cutting edge at right angles to the surface. A light stroke makes a light tone. Variations in directions and

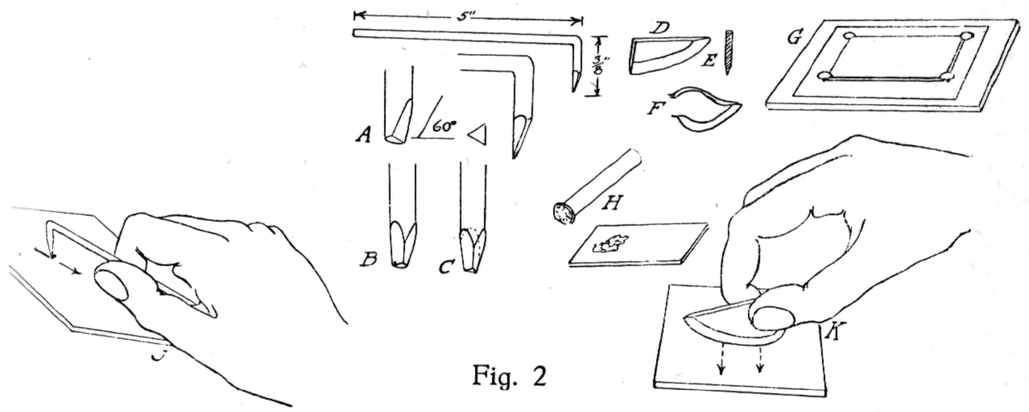


Fig. 2

pressure produce the desired contrasts. Test with chalk as the etching process progresses.

Sandpaper may also be used for producing contrasts. For small areas attach a piece of No. 00 sand paper to the end of a stick with sealing wax or cement, Sketch H. Apply to the celluloid with a rotating motion. Large areas may be hand rubbed with pieces of sand paper.

4. **Highlighting.** The scraped surface, or one roughened with sand paper may be burnished by rubbing over it a highly polished metal surface, such as a leather modeling tool or metal burnisher. A chamois covered stick rubbed over the etched surface will produce a still softer tone.

5. Remove the sheet celluloid from the board and trim it down to the desired size. Wash out the chalk with warm water and a soft brush.

Printing from an Etched Celluloid Plate

The etched sheet of celluloid must be attached to a firm base before it can be printed. There are several methods of applying the pressure required

to make creditable prints. The screw type letter press is satisfactory since it provides a positive pressure control. Successful prints have been made using a clothes wringer for a press, although the pressure control is variable. Portable commercial presses are available which are ideal for the purpose. A hand roller may also be used successfully.

1. Letter Press Method.

Tools: Etched Celluloid Plate, Letter Press. A piece of sheet metal plate the size of the press plate (galvanized iron about 20 gauge), Plywood Board, Newspapers, Soap, Blotting Paper.

Materials: Etching Paper, Ink.

Instruction:

1. Apply a piece of bond paper to the sheet metal with household cement and permit it to dry. Mark on the paper the marginal position of both the etched plate and the print paper.

2. Attach the etched celluloid plate to the sheet metal in the position indicated for it by the guide lines, using laundry soap as the adhesive. To apply the soap turn the etched plate face downward and rub the bar on the back. Reverse and place it in position on the metal sheet. Cover the etched surface with a piece of blotting paper and apply pressure with the hand to make the metal contact at all points. Wipe off any excess soap exuding from the edge with a damp cloth.

3. Attach two guide strips of celluloid to the metal press plate as shown in Fig. 3, page 231. These serve to properly position the paper upon the etched plate.

4. Prepare the paper, and ink the plate as described on page 232.

5. Place on the base plate of the press the following. Several thicknesses of newspaper, the plywood board, a piece of blotting paper, the metal sheet with the celluloid plate attached, then lay the etching paper over the inked plate. Cover with a few thicknesses of newspaper and apply pressure with the hand screw. Uniform close contact must be made and a few trials will determine the degree of pressure required. Inspect the first print for any unequalities in pressure or insufficient ink. If necessary level the plate by adding newspaper under the plywood.

Remove the print and place between sheets of clean paper (paper towels) to dry. Add sufficient weight to hold the sheet flat but not enough to flatten the ink.

2. Clothes Wringer Method:

Tools: Etched Celluloid Plate. Clothes Wringer. A piece of sheet metal No. 11 gauge or approximately 3/32" thick. Pieces of felt the size of the metal plate.

Materials: Paper, Ink.

Instruction:

Steps 1, 2, 3 and 4 are described above under the Letter Press Method.

5. Lay the etching paper over the inked plate and cover with the three felt pieces which are overlapped as shown in Fig. 4, page 232.

6. Attach the clothes wringer to a firm support and adjust the space between the rollers to receive the edge of the plate. Insert the plate so that the top layer of the felt enters the rollers. Tighten the set screws to adjust the pressure. Pass the plates between the rollers without stopping the motion of the crank. Inspect the print to determine if sufficient pressure is exerted to give a clear impression. If additional passes through the wringer are required, insert the plate from the same end each time.

3. Hand Roller Method:

Excellent results have been obtained in printing from etched celluloid plates without a press. The printing paper is forced into contact with the inked plate by the pressure of a hand roller.

Tools: Etched Celluloid Plate. Hand Roller, such as the rubber covered roller used in mounting photographs. A Drawing Board, a piece of Sheet Metal, galvanized iron about 20 gauge.

Materials: Etching Paper, Ink.

Instruction:

1. Apply a piece of bond paper to the sheet metal with household cement and permit it to dry. Mark the position of the etched plate on the paper, allowing the same margin as desired on the finished print.

2. Nail the two wooden cleats to the drawing board as indicated in Fig. 4, to serve as a stop for both the base plate and the printing paper.

3. Attach the etched celluloid plate to the sheet metal using laundry soap as the adhesive. Apply as directed under Letter Press method.

4. Place the metal plate with the celluloid plate attached upon the drawing board and in contact with the cleats. Press three thumb tacks into the board to the position shown to hold the metal sheet in contact with the cleats.

5. Prepare the paper, and ink the plate as described on page 232.

6. Place the etching paper over the metal plate in contact with the cleats and hold it with the hand as shown in Sketch B.

7. Apply the hand roller along the margin of the etched plate with a gentle pressure. Roll each margin toward the cleat in the direction indicated, Sketch B so that the edge of printing paper is held in contact with the cleats. The lower margin of the paper is held firmly against the plate with the left hand during the rolling process.

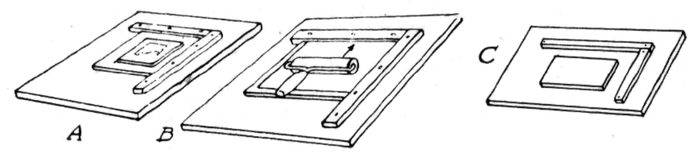


Fig. 3

The moist printing paper is somewhat translucent, and from the top or back of the print a color variation is observed between the inked and blank areas. This is a reliable index of the proper degree of inking and shows where additional pressure should be applied to bring the paper into contact with the ink so that the impression will be uniform. The ink does not come through the paper and when the print is dry this effect disappears.

8. Remove the print and place between sheets of clean paper towels to dry. Add sufficient weight to hold the sheets flat but not enough to flatten the ink.

Inking the Etched Plate.

The application of ink to the etched plate involves not only filling the grooves with ink but the removal of any excess which may adhere to the surface of the plate between the etched lines.

Tools: Mixing Plate and Spatula. Inking Pads or Daubers, Wiping Cloths, Turpentine, Soap and Water.

Materials: Etching Inks, Thinner.

CELLULOID

Instruction:

1. Squeeze a small amount of ink from the tube, place a few drops of thinner upon it and work it with the spatula to a uniform consistency. When the softened ink drops from the spatula and forms a mound that flattens out it is of the proper consistency for use.

2. Make an ink applicator out of cheese cloth or gauze free from lint. Apply the ink to the plate with the pad, starting at one corner. Rub across the plate and back, slightly overlapping each stroke. Continue until the plate has been traversed over both length and breadth. Care must be taken not to wipe ink out of the grooves on the return stroke. See Sketch B, below.

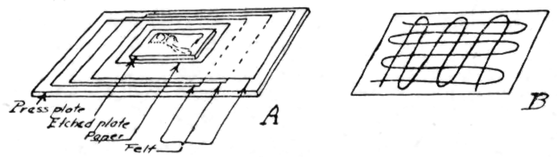


Fig. 4

3. Remove any ink which has spread across the surface of the plate with a clean cloth. Wipe the plate with a spiral motion beginning at the center and without exerting sufficient pressure to remove ink from the grooves. Repeat the process until the cloth appears clean after rubbing the surface. Inspect the inked surface to make sure all grooves are filled with ink. Test the surface afterwards with the hand. Unfilled grooves should be refilled with ink rubbed in with the dauber or finger. In some subjects high lights should be made more prominent by removing ink from the grooves with a soft cloth drawn snugly over the end of the finger or a pencil. Carefully inspect edges of the plate for surplus ink and remove with a cloth dampened in turpentine. Afterwards wipe off all trace of the turpentine with a cloth dipped in gasoline.

Preparation of Etch Printing Paper

Papers suitable for printing from etched plates come in varying degrees of smoothness or texture and may also be classified by the hot or cold process of manufacture.

The paper should be soaked in water for about an hour before it is ready to use. Each sheet is removed from the water bath as needed and placed between two sheets of blotting paper or paper towels and squeezed or pressed with a roller to remove the excess water. The sheet is then ready to print.

Care of an Etched Celluloid Plate

Each time a print is made the ink is removed from the plate. It must then be re-inked before another impression is taken. After the last print is made and before the ink is dry, remove all trace by wiping it with a cloth dipped in gasoline. Then wash with soap and warm water and dry with a soft cloth. Remove plate from the metal sheet by inserting a knife blade at one corner to loosen the celluloid so that it may be lifted and peeled off. Wash with warm water to remove the soap.

If corrections to an etched plate are necessary, collodion may be applied with a small brush to fill the grooves in the area to be altered.

Weaving

WEAVING TECHNICS OF THE SOUTHWEST

Weaving processes were known and used to some extent by all primitive peoples. The making of thread by twisting fibers of vegetables and animal tissues was the fore-runner of weaving. These twisted strands of fiber were employed by various techniques—plaited, braided, twined, looped, knitted, netted—to make protective coverings. Baskets and blankets as we know them are both woven structures. The characteristics of each are due mainly to the influence of the material used. The basic technic of using longitudinal foundation (threads) interlaced by a single continuous thread has come to be known as the basket or plain cloth weave. In the beginning the weaving processes were finger technics. Necessity demanded better use of time spent in weaving and ingenuity developed a machine to expedite the process. Not so long ago these longitudinal threads were attached to a support over head at one end only. The other ends dangled and tangled freely. Later both ends of these threads were made fast. To interlace them with the continuous single thread led to the practice of warping them out of line to facilitate passage of the weft thread. This warping process has given to these longitudinal threads the name warp. The steady improvement and perfection of this process is a record of achievement in mankind's struggle with the elemental. All primitive people since the stone age have given thought to weaving. In our own Southwest the weaving techniques of the Navaho Indian and those of the Basket making Indians reflect the degree and perfection of skill achieved in our own country.

Weaving of cotton fabrics was practiced by the Pueblo Indians prior to the coming of the Spaniards who introduced sheep and wool. It is also known that a primitive loom was used by certain of the Cliff Dwellers, and this may have been the prototype of the Navaho loom. The Navaho Indians have been notably clever in the art of acquisition, both of material things and of ideas. They show unusual originality and ingenuity in this appropriation and adaptation of the arts and skills of other peoples to their own use. No doubt their artistic appreciation and its expression in their crafts have contributed to the well being and industry of this nomadic and pastoral people, which have continued to grow and thrive in the waste lands of the Southwest.

Navaho weaving is distinctly a finger craft product, made on a loom, and the Navaho technique lends itself to a greater variety of design, both style and color, than does the shuttle craft technic of Chimayo weaving which was a transplant from Continental Europe, coming directly through those Spanish colonists who located in the valley of the Rio Grande. In the vicinity of the present village, Chimayo, live Spanish Americans, descendants of the colonists, who weave on foot power looms the blankets and fabrics which bear the name of the village.

The early Spanish weaving was almost entirely a shuttle craft procedure and the fabric was woven from home spun yarn made from wool grown on the sheep which the Spanish colonists brought with them to the Southwest and introduced to the natives. Originally it possessed but little variety in design. The wide stripes or variation of a striped pattern enclosing areas of solid color prevailed, since this design pattern could be produced by a complete passage of the shuttle through the shed. The modern Chimayo weaver utilizes the finger weaving technique, developed by the Navaho, in conjunction with the shuttle craft technique introduced by his Spanish ancestor. This combination of the two weaving technics enabled the Chimayo weaver to enrich his blankets and fabrics with the colorful design

motifs adapted from the Navaho. On the other hand the older Navaho blankets show distinctly the Spanish influence. They were largely of the striped variety, similar to the old Chimayo patterns and designs, but this period of borrowed design did not last long for the creative genius of the Navaho soon asserted itself. Designs peculiarly Navaho appeared, zig-zag stripes came first, then stepped patterns, followed by triangular areas in contrasting colors, and later symbolic designs and patterns were developed.

The Indian trader, seeking outlet for Navaho woven fabrics, is perhaps the source of inspiration for the Navaho rug. The blanket originally made by the Indian for his own use was soft and pliable, entirely suited to his needs as a body covering for day or night wear. As such utility was too limited for the white man's commerce the Indian trader insisted that heavier blankets be woven. The designs were modified and rug patterns with borders surrounding central areas were requested of the Navaho weaver. Some of the resultant creations are most inartistic as might be expected. The weaver was conforming to the wishes of a merchant, uncertain of design and pattern, but wanting something different. Indefinite, haphazard specifications, embodying designs impossible of being expressed within the limited range of her technique, were thrust upon the Navaho weaver. It is little wonder that we find atrocious examples of the weaver's effort to conform to the trader's wishes. Imagine the struggle the weaver experienced in trying to weave such designs as a railroad locomotive, wagons, horses, initial letters!

This kind of experience, however, was not without some benefit to the Navaho weaver. A different viewpoint had been presented, and the weaver had to be given more freedom of expression and choice in the selection of design motifs. In recent years many have been taken from the sand paintings of the medicine men, and these symbolic designs have been sought after by the trader's white customers. The Navaho has learned that shoddy work is poor business and that there is a demand for artistic design and a growing appreciation for good craftsmanship in his hand woven fabrics.

THE FIRST BLANKET

Adapted

The Navahos preserve in chants and legends the traditional story of their origin, and the acquisition and development of the skills which make them unique among the natives of the Southwest. A strange creature, called the Spider Woman, with both human and animal attributes, appears in many of these legends. The following is an adaptation of the Navaho story of the first blanket.

Many, many winters ago there lived a lonely Kisani woman who wandered sadly among the hohrahns of the Navahos. Fair was her face, and her spirit gentle, yet no man looked upon her with favour, nor wished her for his wife, and so she went about, earning her living as best she could grinding corn.

One day she set out alone across the Great Prairie, and no one noticed her going nor longed for her return. On the second morning she came upon a hole in the earth, and there was the Spider Woman, who invited the girl down into her house, where she was weaving something. Quietly the Kisani girl sat beside the old woman and watched her threading a long stick like a great needle, in and out among some other threads, making what she called "Black Design"; and this was the very first kind of blanket.

After she had finished Black Design Blanket, the Spider Woman went up to the top of the ground and pulled the Sun low. Then she asked the girl to stay with her that night. Four days the Kisani girl remained with the Spider Woman, and watched her as she wove four blankets, each one different in design. On the fifth day the girl went back to the hohrahns of the Navahos. She asked them to bring her yellow, black, and white cotton, and when they had done so, she set up a loom and began a blanket. The men and women who never had looked at the Kisani woman before, came and stood about her loom all that day, watching her skillful fingers ply the shuttle in and out, blending the colours to make a picture of a bird on both sides of the blanket. For the first time in her life the Kisani woman smiled as she worked, and her heart was light.

The Navaho men and women watched her every day and then went off to weave beautiful blankets for themselves. One day the Kisani woman set forth again across the Prairie, and this time the people talked among themselves eagerly of when she would return. When she came home once more, she taught them how to make carrying baskets and water jars. But one word of warning she spoke to her people: "Remember. Our hearts are grateful to the Spider Woman, and for this reason we shall leave in the center of every blanket a hole, just as she does. Through this hole the evil spirits will escape; a weaver who does not leave the opening will bring ill fortune upon herself, and the cobwebs will spin themselves in her head until she shall lose her mind."

And thereafter, the blankets of the Navahos were always made with a hole in the center, like the hole in the middle of the Spider's web.

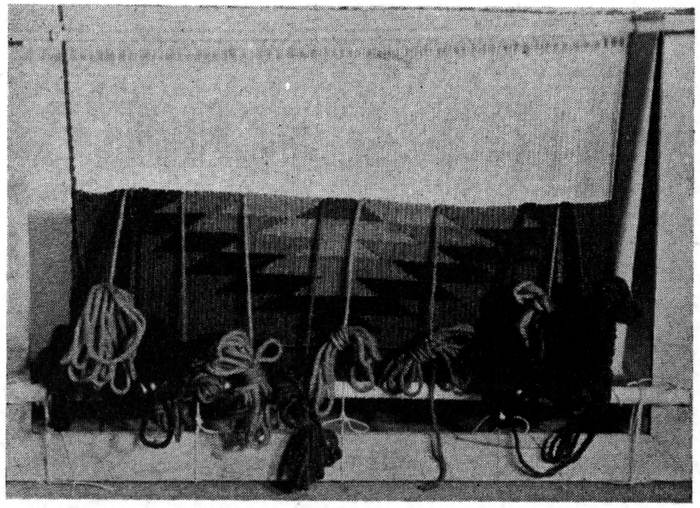
WEAVING—NAVAHO METHOD

In presenting the weaving technique of the Navaho Indian as a project in Handicraft, we have in mind preserving the primitive touch for the Recreational groups interested in building an Indian lore program, also for the Educational field where the interest is mainly that of an elementary study of the primitive process in weaving techniques.

For the individual or family as a Hobby project, Navaho weaving has much to recommend its use. The fact that it is primitive and distinctly American makes an appeal to all members of a family; the children, for whom anything Indian has a natural fascination, the adolescent group, which here finds expression for the creative urge, and the adult, who needs the relaxation and stimulus of a leisure time hobby. For all it is a satisfying occupation for a prolonged interest period.

The Navaho Loom

The rigging of this primitive weaving mechanism is most clearly described by Washington Matthews, "sympathetic observer, unbiased student, faithful recorder, of Navaho life and ways," who observed the technique of native weavers. It was his good fortune to live in the Navaho country from 1880 to 1884, serving as surgeon to the Army post, Fort Wingate, New Mexico. His observations are contained in Volume III. Bureau of American Ethnology, Smithsonian Institution Report for 1884, pages 466 to 469. This classic commentary is also contained in the book* "Navaho Weaving" by Charles Avery Amsden.



In presenting the technic employed by the Navaho weavers at this time modern equipment will be utilized. A loom frame constructed with dimension lumber and dowel rods will be used instead of the primitive materials—poles lashed together and attached to living trees or the hogan timbers with rope or thongs. It is recommended that the beginner use cotton string warp instead of wool until the procedure is mastered. This will obviate certain difficulties presented by the wool warp. Wool, of course, is to be preferred for the construction of Navaho style blankets and rugs.

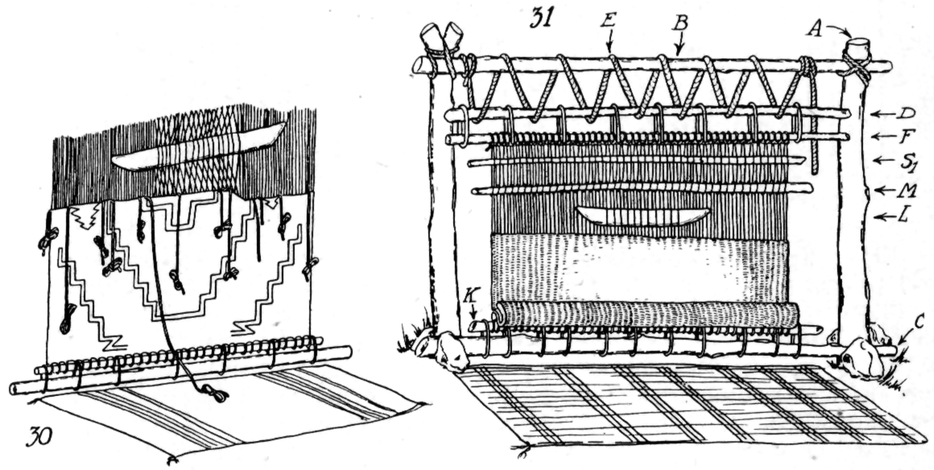
*This book should be available in every public, college and school library. The revival of interest in handcrafts has stimulated a growing and insistent demand for authentic source material. "Navaho Weaving" is more than a treatise of technics and skills. It is a faithful presentation of Navaho life, ways and achievement. Through mastery of skills Navaho life has been enriched. The "He Who Always Wins" attitude and viewpoint of these virile industrious people is a trait to which may be attributed their preservation and survival in a land of scarcity.

Mastery of technics and the expression of artistic conceptions give the inherent quality to Navaho craftsmanship. His handwork challenges our admiration, and imbues us with a wholeome respect for the artisan. The general reader will find this book stimulating further inquiry in a fertile field for exploration. It provides subject matter for individual and family leisure time activity. The teacher, student, craftsman, recreation supervisor, will find this source book indispensable.

"Navaho Weaving, It's Technics and History," by Charles Avery Amsden. Published by the Fine Arts Press, Santa Ana, California, in cooperation with the Southwest Museum in 1934.

*In making a blanket the operator sits on the ground with her legs folded under her. The warp hangs vertically before her—she weaves from below upwards. As she never rises from this squatting posture when at work, it is evident that when she has woven the web to a certain height, further work must become inconvenient or impossible unless by some arrangement the finished web is drawn downwards. Her cloth beam does not revolve as in our looms, so she brings her work within easy reach by the following method: The spiral rope E, Sketch 31, is loosened, the yarn-beam is lowered to the desired distance, a fold is made in the loosened web, and the upper edge of the fold is sewed down tightly to the cloth-beam. In all new blankets over two feet long the marks of this sewing are to be seen, and they often remain until the blanket is worn out.

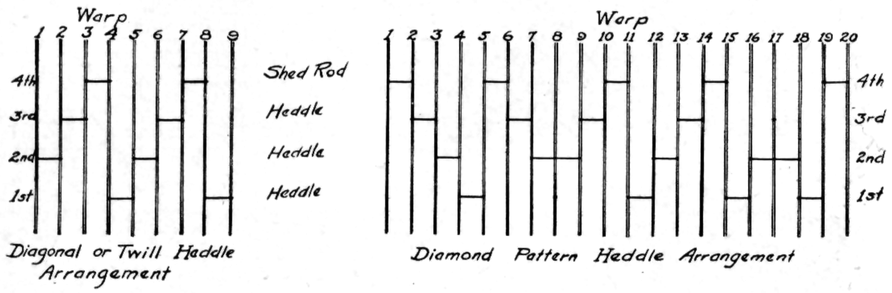
"It is of course desirable, at least in handsome blankets of intricate pattern, to have both ends uniform even if the figure be a little faulty in the center. To accomplish this some of the best weavers depend on a careful estimate of the length of each figure before they begin, and weave continuously in one direction; but the majority weave a little portion of the upper end before they finish the middle. Sometimes this is done by weaving from above downwards; at other times it is done by turning the loom upside down, and working from below upwards in the ordinary manner.



*"Navaho Weavers," Washington Matthews. Vol. III, Bureau of American Ethnology, Smithsonian Institution.

"Two Posts, AA, are set firmly in the ground, to these are lashed two cross-pieces or braces, BC, the whole forming the frame of the loom. D is a horizontal pole, which I call the supplementary yarn-beam, attached to the upper brace, B, by means of a rope, E, spirally applied. F is the upper beam of the loom. It lies parallel to the pole D, about 2 or 3 inches below it and is attached to the latter by a number of loops. A spiral cord wound around the yarn beam holds the upper border cord—which in turn secures the upper end of the warp. The lower beam of the loom is shown at K. I will call this the cloth-beam, although the finished web is never wound around it; it is tied firmly to the lower brace, C, of the frame, and to it is secured the lower border cord of the blanket. Lying between the threads of the warp is depicted a broad, thin, oaken stick, L, which I will call the batten. A set of healds (heddles) attached to the heald-rod, M, are shown above the batten. These healds are made of cord or yarn; they include alternate threads of the warp, and serve when drawn forward to open the lower shed. The upper shed is kept patent by a stout rod, S-1 (having no healds attached), which I name the shed-rod. Their substitute for the reed of our looms is a wooden fork, which will be designated as the reed-fork. (Sketch 29, Fig. 4, page 244.)

"Navaho blankets are single-ply, with designs the same on both side no matter how elaborate these designs may be. To produce their variegated patterns they have a separate skein, shuttle or thread for each component of the pattern. Take for instance the blanket depicted in Sketch 30. page 237. Across this blanket are shown a number of different weft threads hanging from the face of the web.



"For making diagonals the warp is divided into four sheds; the uppermost one is provided with a shed-rod, the others are supplied with healds. I will number the healds (heddles) from below upwards. The following diagram shows how the threads of the warp are arranged in the healds and on the rod. When the weaver wishes the diagonal ridges to run upwards from right to left, she opens sheds in regular order from below upwards, thus: first, second, third, fourth, first, second, third, fourth, etc. When she wishes the ridges to trend in the contrary direction she opens the sheds in the inverse order. The lowest (first) shed is opened and the first set of healds drawn forward. There is a variety of diagonal weaving practiced by the Navahos which produces diamond figures; for this the mechanism is the same as that just described, except that the healds are arranged differently in the warp. The following diagram will explain this arrangement. To make the most approved series of diamonds the sheds are opened twice in the direct order (i. e. from below upwards) and twice in the inverse order, thus: First, second, third, fourth, third, second, first, fourth and so on. If this order is departed from, the figures become irregular."

*"Navaho Weavers," Washington Matthews. Vol. III, Bureau of American Ethnology. Smithsonian Institution.

Loom Construction

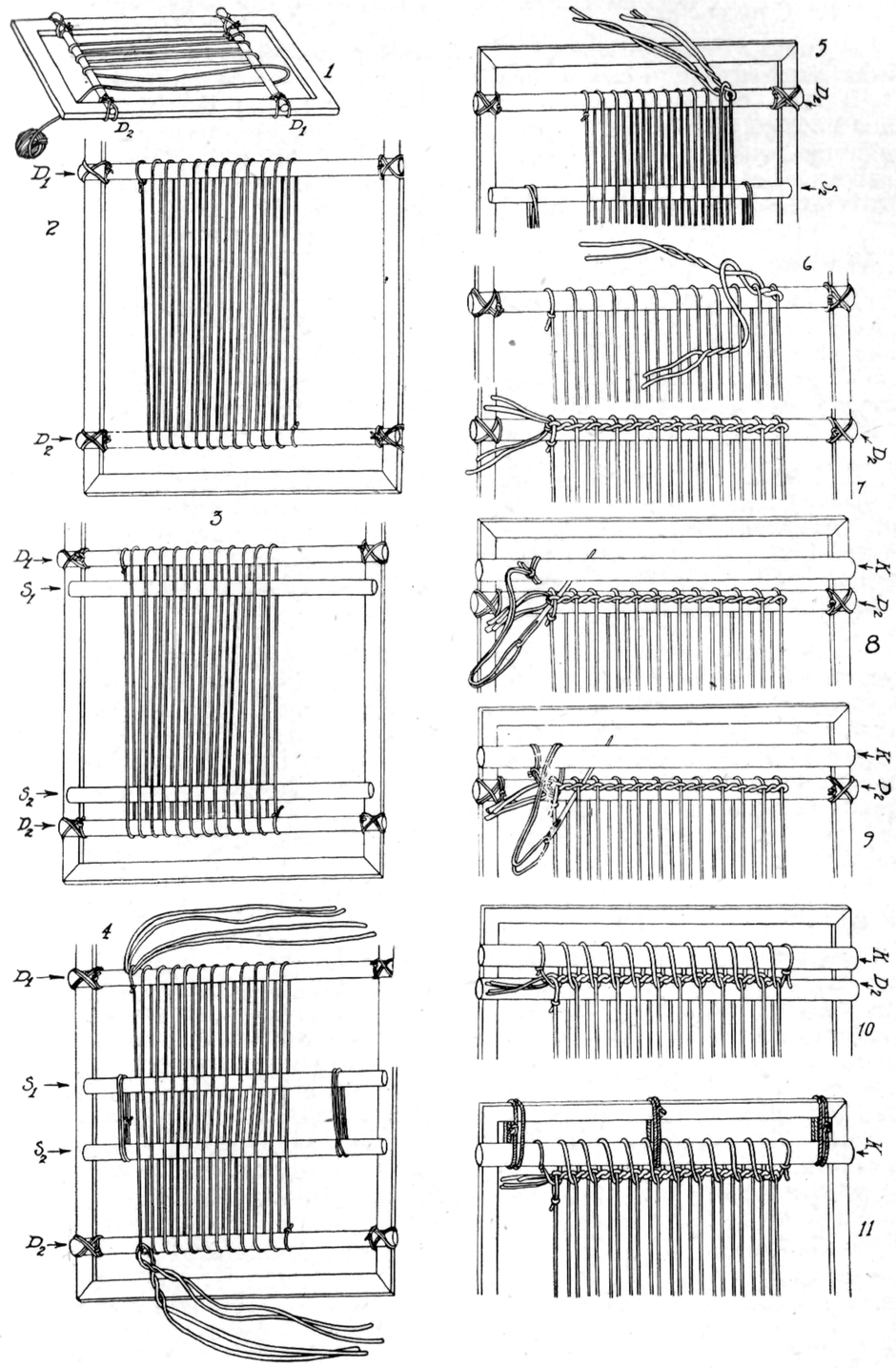


Fig. 1

I. Frame Construction.

A. Build a frame of the proper dimensions to permit weaving a fabric of the required size. Place it on supports in a horizontal position.

B. Lash two dowel rods or sticks, D-1 and D-2 to the frame as indicated in Sketch 1, Figure 1. These rods serve only as a temporary support while the warping of the loom is done, hence the lashing need not be elaborate, but readily untied. Allow about 6 inches of working space between the rods and each end of the frame.

II. Warping the Loom.

A. Tie one end of the warp to Rod D-1, Sketch 1. In case the warp used is wound in ball form, pull from the center of the ball. Carry the ball or spool of warp over Rod D-2 and back to Rod D-1. Again carry the warp over Rod D-1. Continue to apply the desired number of warp threads, carrying each one over Rods D-1 and D-2. Tie the free end of the warp to Rod D-2 as indicated in Sketch 2.

B. Into the space between warp threads just inside Rods D-1 and D-2, insert dowel rods or stick, S-1 and S-2 as shown in Sketch 3. Slide these rods toward the center of the loom and tie them together temporarily as shown in Sketch 4. Inspect the warp to make certain that each thread passing over stick S-1 also passes under stick S-2. Alternate threads pass under S-1 and over S-2.

C. Space the warp threads equidistant and secure them in their correct position by inserting the end selvage or border cord. Slip two lengths of the coarse yarn twisted into a single firm strand, around the left hand warp thread and suspend it from the middle point, Sketch 4. Twist the two ends of yarn together as indicated in Sketches 5, 6 and 7. One or more twists between warp threads may be used to give the proper spacing of warp threads. Sketch 6 shows one twist in selvage yarn between warp threads, also the two strands of yarn tied together around the last warp thread. Sketch 7.

III. Attaching the Warp.

A. Attach the warp to the cloth beam by wrapping a strong cord around the selvage and Rod K (which should be as large as Rod D-2 or larger). Pass the cord through each warp loop, when carrying it around the selvage, thus attaching the selvage to the cloth beam. See sketches 8, 9 and 10. This process carries the tension from the warp threads to the cloth beam K. Remove Rod D-2, Sketch 10, and tie Rod K securely to the frame as indicated in Sketch 11. Tighten the seizing cord, which is shown loosely applied in order that its application and function may be indicated. Repeat the procedure at the other end of the warp and remove Rod D-1, after attaching another cloth beam F, to the warp and selvage. The tension on the warp threads is made adjustable by tying the warp beam F to the frame, Sketch 12, Fig. 2.

*The Navaho practice is to wrap the cord, seizing the selvage around the cloth beam K without special reference to the warp loops. However, for small fabrics it is preferable to pass the cord, seizing the selvage to the cloth beam K through each warp loop as well as around the selvage. See Sketch 8-9-10. This practice equalizes the tension on each warp thread.

Navaho Loom

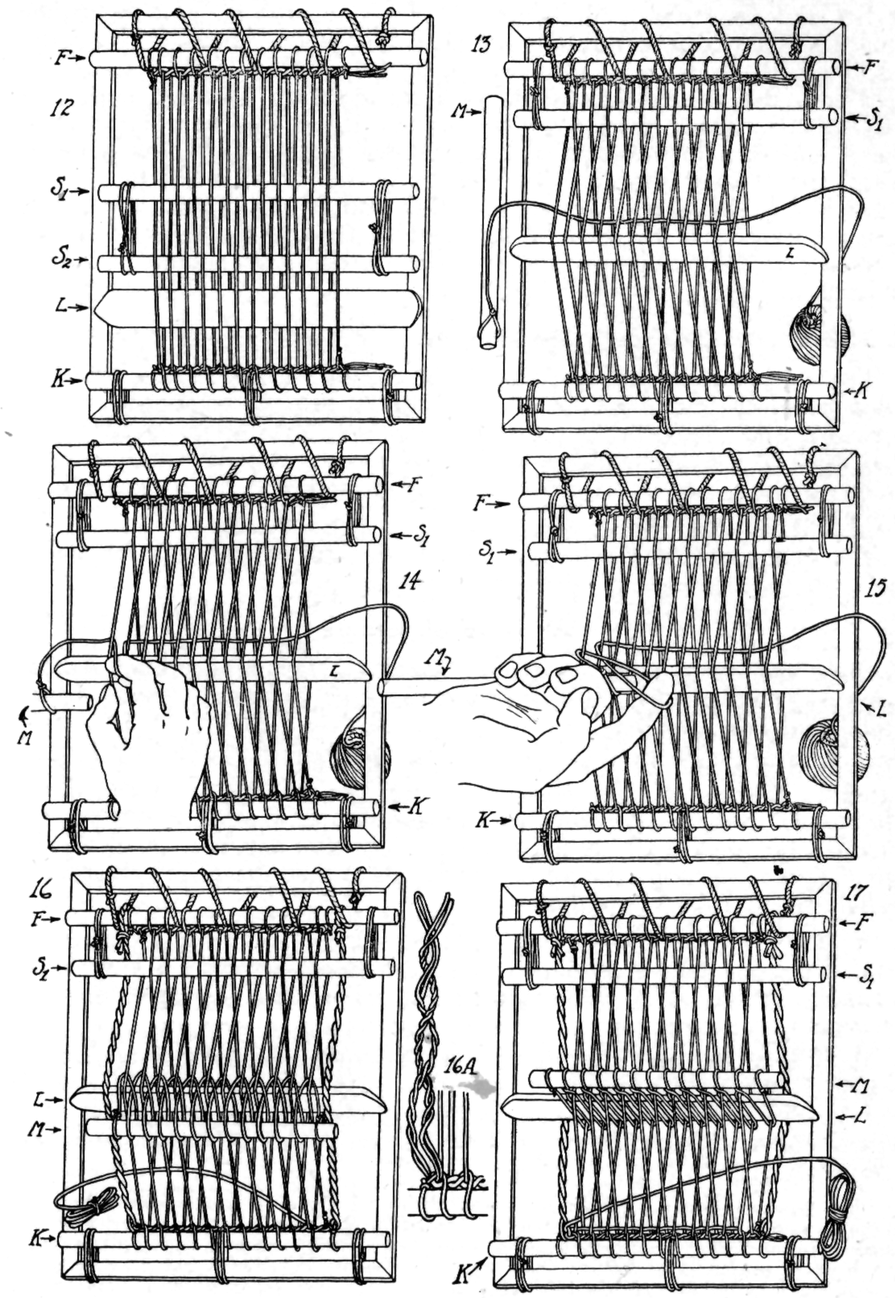


Fig. 2

Navaho Loom

IV. Construction of the Heddle.

A. Refer to Sketch 12, Fig. 2, and note that the batten has been passed through the shed separated by lease Rod S-2. Remove Rod S-2 and move Rod S-1 out near the cloth beam, F. Tie S-1 with a cord as shown in Sketch 13. Pass a cord through the shed above the batten, L, and tie the end to Rod M, Sketch 13. This cord should come from a ball or spool and be fed into the shed as required. Pull the cord up between each pair of warp threads, which pass over the batten L, as indicated in Sketch 14. Make a half turn in the loop of cord, shown around the forefinger, Sketch 14, and slip it over the Heddle, Rod M, as indicated in Sketch 15. Keep the loops free from overlapping, as the Rod M is slipped through each additional loop. Tie the end of the cord to the Heddle Rod M as shown in Sketch 16. The minimum length of the Heddle loop should be the width of batten L.

V. Making the Side or Edge Selvage.

The side or edge selvage is made of coarse yarn. Insert a strand twice the length of the warp in the end selvage at the bottom of the warp, see Sketch 16, and secure it to the cloth beam, K. See 16A for larger detail of selvage. Twist the ends of this yarn loosely together and carry them parallel to the outer warp thread extending from the cloth beams K to F. Tie the ends to cloth beam F.

This completes the set-up of the loom. All work thus far has been done with the frame in a horizontal position.

Weaving Procedure

Place the frame in a vertical position and fasten securely. Adjust the tension rope at the top of the frame to make the cloth beams K and F parallel and horizontal.

I. Pass the end of the ball of yarn through the shed held open by *batten L, Sketch 16, and press it against the selvage with the thin edge of batten L. Sketch 16 shows the appearance of the warp when the shed controlled by the Heddle is uppermost. Note that the bottom of the heddle loops are over the top edge of batten L. Also that the edge selvage always parallels the outside warp thread.

II. To change the shed remove batten L and pass it through the space in the warp just below shed rod, S-1. Sketch 17 shows the opposite shed held open by batten L. Note the heddle loops now appear at the bottom of batten L.

III. Carry the ball or roll of yarn around the edge selvage and back through the shed. (Open space between warp below the batten, as shown in Sketch 17.) Press this strand of yarn firmly against the fabric with the wooden comb, Sketch 29, page 244; for its use see Sketch 22A, Fig. 3. Remove the batten.

*The type of batten recommended and illustrated here is longer than that used by Navaho weavers. It serves to keep the entire shed open which is desirable for the beginner, since it facilitates weaving an entire weft shot before changing the shed. The native weaver uses a short batten. Due to the width of the blanket she frequently confines her weaving to a portion of the blanket which she can conveniently reach from one seated position. In weaving fabrics where many designs in different colors are employed, the short batten is inserted between the warp threads required for each color. A very sharp blow which compacts the weft firmly together is delivered by bringing down the short batten, between a few warp threads. It is not possible to compact the weft as firmly with a long batten as with the short one. The wooden comb is frequently used to compress the weft where needed.

IV. Change the shed by lifting the warp threads controlled by the heddle rod M sufficiently to permit passing the batten L. Pass the roll of yarn through the new shed and between the loosely twisted strands of edge selvage as shown in Sketch 18. Sketch 19 shows a ball of yarn loosely wound, being passed along in a shed, transferred from hand to hand. No shuttle is used by Navaho weavers. Sometimes the yarn is wound on a small stick to facilitate passage as the shed space becomes restricted. See Sketch 25. Press the weft yarn into place by striking it with the edge of the batten L. This is the operation known as "bringing down the batten," shown in Sketch 22B. Remove batten. The opposite shed is opened as described in paragraph II above.

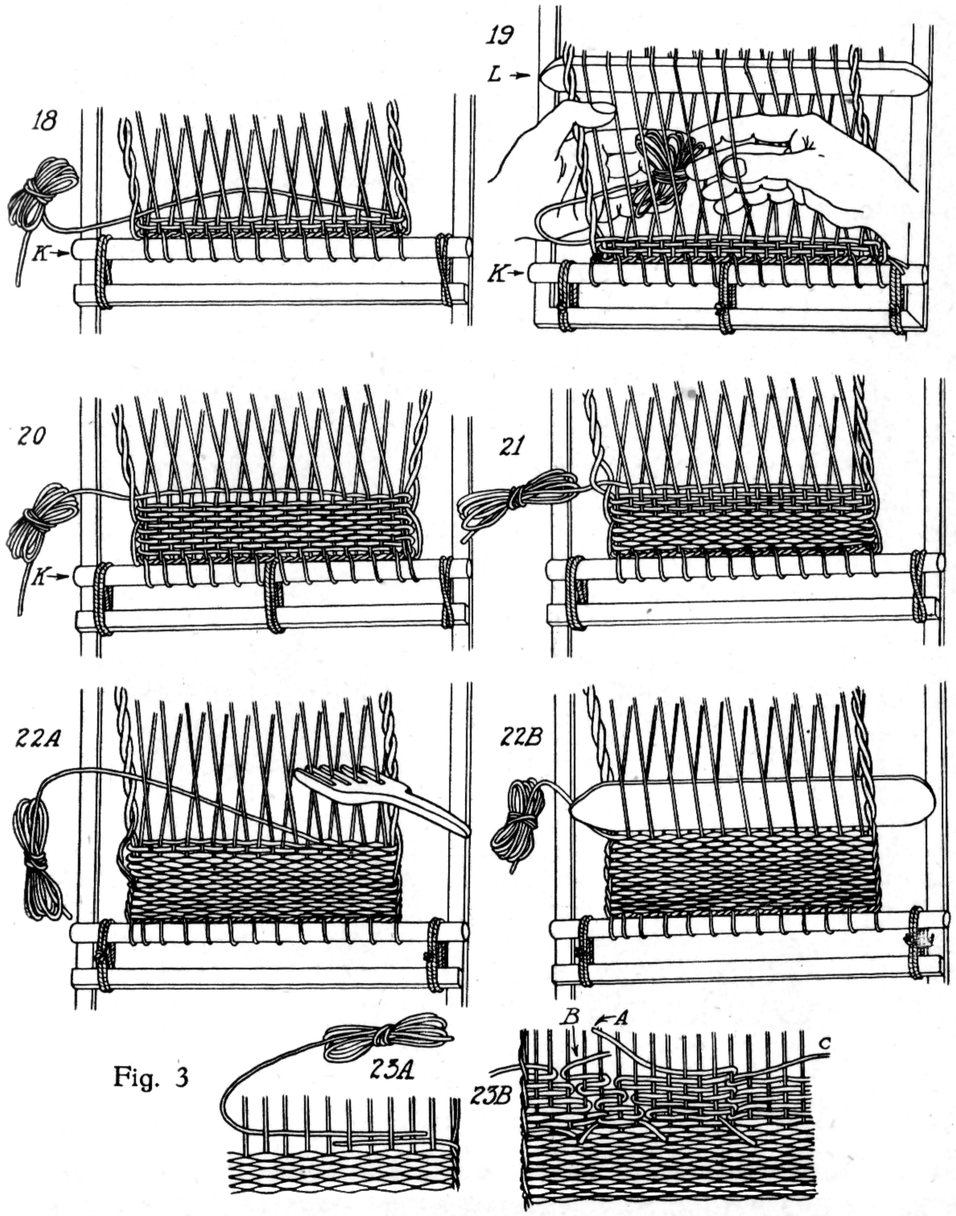


Fig. 3

Technics Used in Plain Weaving

The set-up of the primitive mechanism used in plain weaving by the Navaho has been detailed in the foregoing paragraphs. Its operation has been indicated. It remains for beginners to learn the native technic and procedures in weaving fabric with such equipment. A close inspection of the accompanying sketches should make this possible.

Sketch 23-a, page 243, indicates a method of adding yarn. The short end of yarn is carried around the selvage and placed in the shed, where it is overlapped by the end of yarn from the new ball. This splice should not be made at the edge of the fabric.

In Sketch 23-b, two technics are shown which the weaver uses in producing designs. The path traced by weft yarn A indicates the procedure in producing both a vertical and diagonal design line in the woven fabric, where contrasting colors are used. The junction between yarns A and C, accomplished by carrying each around the same warp thread, produces the vertical design element. The junction between yarns A and B indicated in Sketch 23-b, carried either to the right or left, produces the diagonal design element. The path indicated by yarn B produces a border sometimes used to outline designs.

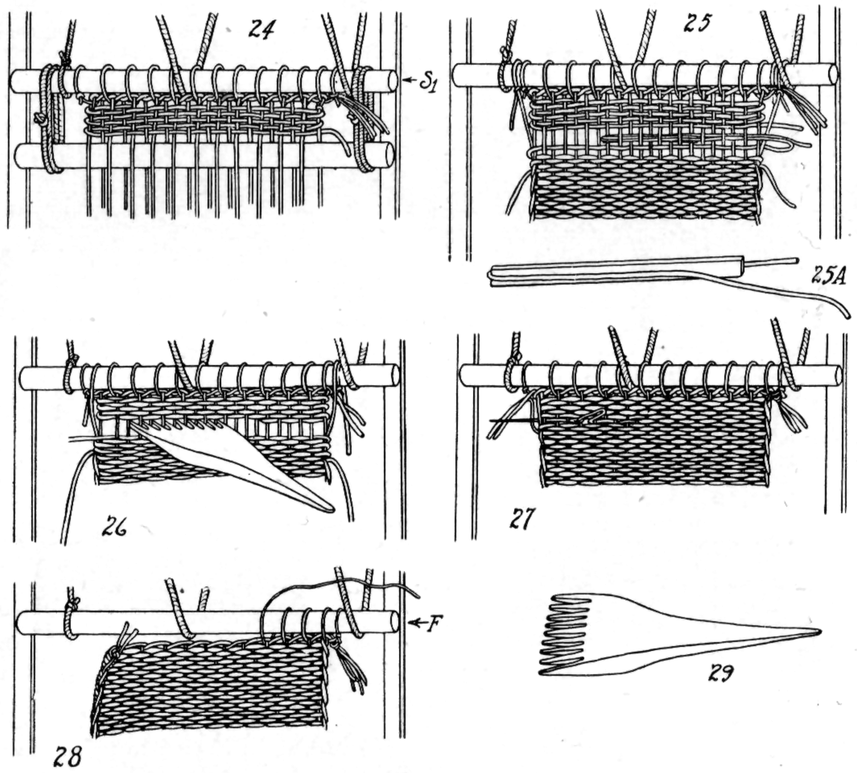


Fig. 4

Design weaving is distinctly a finger weaving process and the basic element is developed by twining the weft yarn about the warp. This twining procedure requires close inspection of the shed at all times.

In the process of carrying weft yarn around a warp thread, care must be exercised to preserve pattern arrangement at each junction of weft colors. The pattern to be kept in mind is visualized best by reference to the parallel warp when the shed is closed. Some confusion occurs when reference is made to an open shed.

As the weaving progresses the available shed space decreases and the native weaver usually weaves an inch or more of fabric along the upper selvage as indicated in Sketch 24. Remove Rod S1, also the heddle rod and cord. The last few wefts of yarn are woven into place by inserting them on small sticks, see Sketch 25A, or with a needle. The fabric is compacted together on both sides of the unfilled warp area by pressure exerted with the wooden comb, as indicated by Sketch 26. Sketch 27 indicates the last weft yarn being darned in with a needle.

The edge selvage yarn is tied to the end selvage as indicated in Sketches 27 and 28.

The finished fabric is released by removing the seizing cords which secured the warp temporarily to cloth beams F and K as indicated in Sketch 28.

Sketch 29 shows the appearance of the wooden comb used by Navaho weavers.

In Sketch 30, page 237, is shown the appearance of a large blanket in which several colors are used. Each pendant strand of weft yarn represents the color used in the design being woven. After they have all been passed through the open shed in a direction either to the right or left, these colored strands are left hanging as indicated in the sketch. After the opposite shed is made by inserting the short batten the colored weft yarn is passed back in the other direction and again brought out between the warp and left hanging until needed for the next "shot" after changing the shed.

The photograph (Page 236) shows a blanket in which eleven strands of colored yarn are being used to develop the design indicated.

All strands of weft yarn emerge from the left. After a shed change each strand beginning at the left will be carried to the right for the required distance to build each design element.

*A modification of the Navaho weaver's technique is recommended for beginners. It has been mentioned that a batten long enough to keep the shed open for the full width of blanket is a convenience, especially while weaving designs where several colors are used. It helps to preserve alignment and pattern construction, to pass all the different colored yarn strands (ball or skeins) through the open shed in one direction. After changing the shed then pass them all through in the opposite direction. The Navaho weaver may weave one portion of the blanket higher than another while seated in one position. Then, after moving to another position continue weaving the design and bring the pattern to the same level of the other portion previously woven.

Spanish Weaving

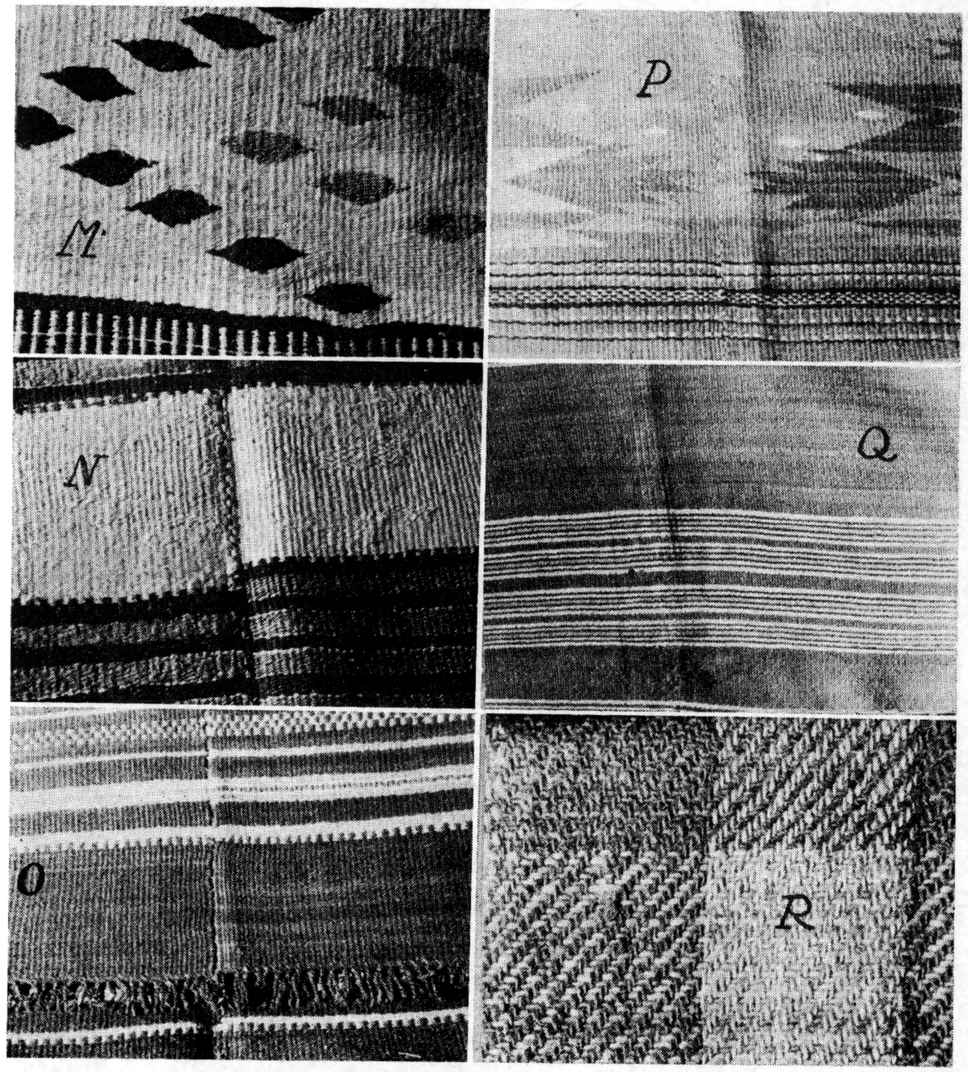
The loom of the Spanish colonist was a counter balanced two harness, two treadle type, usually quite narrow (25" to 28" wide) and constructed with massive hand hewn pine timbers mortised, tenoned and pegged together. String heddles were commonly used. Tension was placed on the warp by rotating the warp beam, with a long lever (a pole) inserted in auger holes drilled in the protruding end of the beam. See photograph D, page 248. The cloth beam was held in place by the action of a ratchet and pawl, also made of wood. Long treadles were hinged in front of the loom. The weaver stood first on one treadle then on the other, her weight being sufficient to change the shed. See Photograph K, which shows a Chimayo weaver at her loom. Note the massive timber construction. The shed is opened by stepping on the left treadle and the shuttle is held in her left hand, ready to be passed through the shed from left to right. The reed is swung on

pivots placed low in the loom frame below the warp. Contrast this with the reed shown in photograph F, page 248, supported by the batten swung from pivots placed above the warp in the overhead loom structure.

There were two methods used by these early weavers, who settled along the Rio Grande, to produce wide fabrics on narrow looms. Two pieces of

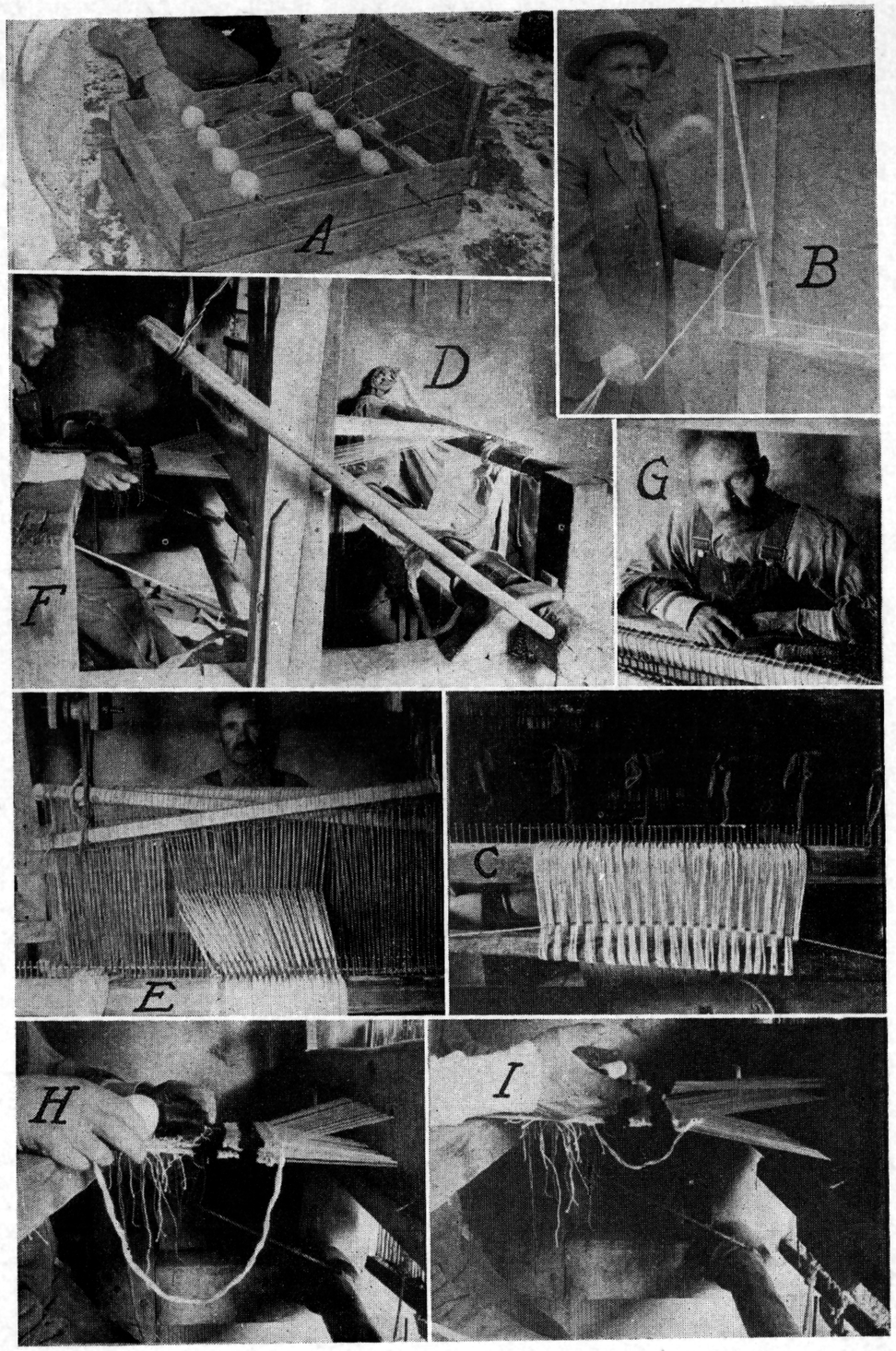
cloth were made, with matched stripes or other design, and joined together side by side with a false warp as indicated by photograph N. The other method, less common, was to weave a wide fabric folded at one edge of the loom. After completing the desired length the blanket was removed from the loom, and opened out to nearly twice the loom width.

A plain stripe pattern in solid colors is monotonous. An attempt to add variety by introducing the "eye" design is shown in Photograph M. It will be noticed from the texture that the weft thread around this design is continuous (not broken as in the Navaho technic used in design weaving)



and passes around the design, this being accomplished by compressing the weft on each side of the design. Another attempt to relieve the monotony of a plain stripe is shown in Photograph O, where a mixture of two colors is twisted into one strand of weft yarn. This gives a variegated background speckled with fine and coarse portions of the home spun yarn.

Photograph N also shows the appearance of the junction of two pieces of fabric. Note the difference in width of the white stripes which have been



*The weaver and owner of the loom appearing in the photographs is Mr. J. Labrado Garcia, who lives on his ranch in the Conejos River Valley.

placed together. Contrast this example with that shown in Photograph P, which is an excellent example of the weaver's skill in matching stripes and also shows finger woven design elements. Here the Indian influence in design elements is notably apparent.

The central section of a blanket woven on a narrow loom is shown in Photograph Q. This central fold can be traced, yet so carefully is it woven that close inspection of the texture is required to detect it. This is an exceptionally fine specimen of a Chimayo blanket*, woven with finely spun yarn in plain stripes. The colors are sand (the background color) white, and blue. (Shown on page 247.)

The older looms in the vicinity of Chimayo, New Mexico, are gradually being replaced by wider ones and to find the old narrow looms one must go farther upstream. In the vicinity of the old Spanish settlements along the headwaters of the Rio Grande, the Conejos, Culebra, Costilla, Los Pinos, Chama, Red River and Aroyo Hondo live Spanish American descendants of the early colonists. This section is better known as the San Luis Valley in south central Colorado, and is not far from the historic spot where Lt. Zebulon Montgomery Pike was captured by the Mexicans and taken to Mexico City in 1807. Here in this broad valley some weaving in the early Chimayo style is still being done today.

In order to weave the blankets of the double width folded style a second pair of heddles and treadles were added to the original two harness loom. Each set of heddles operated independently of each other. The second set of heddles controlled the shed of the upper portion of the double width cloth, while the original set controlled the shed in the lower portion. Some of these blankets were woven with a slit in the center, made large enough to slip over the head for wear as a poncho.

The growing demand for the Chimayo blanket as a bed cover, a wall decoration, and more recently as a fabric of lighter weave for clothing, coats, vests as well as hand and under arm bags has stimulated the building of wider looms, than those used by the Spanish colonists.

The looms in the valley are mainly of the heavy, early Spanish type. A few four harness looms are to be found, on which plain cloth and twill fabrics are woven. The photograph R shows a section of a plaid blanket, woven from red and black homespun wool yarn (warp and weft of about equal weight) in a twill pattern, on a four harness four treadle loom. The early colonial (New England) method of setting up a four harness loom with six treadles (whereby plain cloth could be woven on a loom threaded for twill) is still unknown or has not been adopted by the Valley weavers, who continue as did their early ancestors in Mexico and along the Rio Grande.

The methods employed today by the weavers in the San Luis Valley we may assume to be essentially those handed down by their ancestors. The series of photographs, A to I, show the procedure in warping a loom for weaving the double width blanket on a narrow loom.

The warp thread wound on spools is carried from the improvised spool rack (see Photograph A) to the warping frame shown in Photograph B.

Photograph C shows the warp attached to a stick and the crosses secured by a rope passing between each bundle of eight threads, which are further kept separated and spaced by a row of nails driven in the cross bar just above the warp beam. Photograph D shows a portion of the warp thread attached to the warp beam, also the pole lever passing through a hole in the beam. Photograph E shows the warp thread passing through the string heddles, and the type of pulley support for the harnesses.

*This blanket is in the collection of Mr. Charles H. Woodard of Alamosa, Colorado, and was woven about sixty-five years ago by Mr. Juan Jose Lopez of San Antonio, Colorado. Mr. Lopez is now nearly ninety years of age and lives on his ranch in the Conejos River Valley.

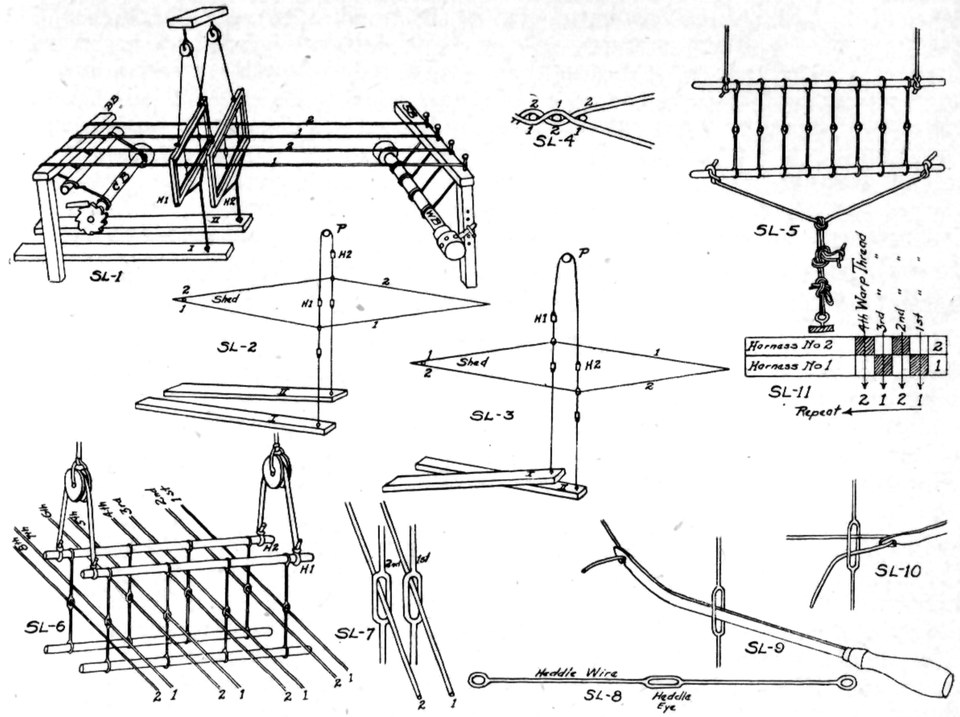
Photograph F. shows the upper end of the warp beam lever held by a loop of wire. Tension is placed on the warp thread by lifting this lever which rotates the warp beam clockwise. This photograph shows the weaver seated on a bench behind the breast beam and his feet on the treadles which operate the four sheds.

Photograph H shows the shed controlling the upper portion of the folded cloth, open and ready to receive the ball of weft. The open edge of the cloth is shown on the weaver's right. Photograph I shows the shed (open) which controls the lower portion of this folded blanket. The *weaver's right hand is inserted in the space between the two edges of the blanket. The ropes attached to the cloth at one end and to the cloth beam at the other, are shown just below the harnesses. The cloth beam is rotated by hand clockwise and held by a pawl against a wooden rachet. After the cloth beam is rotated to the desired position, tension is placed on the warp by rotating the warp beam with the pole lever and securing it by the wire loop. The reed swings from an over head support. The treadles are pivoted at a point almost directly under the warp beam, and tied directly to the harness.

In the language of the weaver this relationship between harnesses and treadles is known as the **Tie-up.** The established order in which the treadles are pressed is known as the **Treadling Draft.** The order in which the warp threads pass through the heddles determines the appearance of the woven fabric. Designs, or patterns, as they are called are produced by a predetermined arrangement of warp and weft on certain types of looms. Each pattern requires a definite order of treadling for a given tie-up, and heddle threading. The weaver's chart which shows the prescribed manner of threading is known as a **Draft.**

The sketches on page 251 indicate the names and relationship of the several parts comprising the simplest form of hand loom, namely the counter-balanced, two harness, two treadle type. It should be understood that the type of loom provides only sufficient mechanism to produce the two sheds required for weaving plain cloth. Striped patterns only can be woven on this type of loom unless the Navaho Indian finger weave technic is used to produce designs. See page 247 for Chimayo blanket designs.

The Sketch SL1 shows four warp threads, 1-2, 1-2, stretched between supports BB (breast beam) and SB (spreader beam). They are numbered from right to left. This reference is with respect to the weaver whose position is at the left end of the loom illustrated. There are only two harnesses used in this loom and they are indicated by numbers H1 and H2 in the Sketch SL-1. The function of the harness is to make the shed by separating the warp threads to facilitate the passage of the weft thread. See Sketch SL-2 and SL-3. The harness is operated by pressing the treadle with the foot. The formation of one shed is indicated in Sketch SL-2,



while the opposite shed is produced as indicated in Sketch SL-3. Treadle I has been pressed down, the harness H-1 has been pulled down also. (See Sketch SL-2.) The rope which is attached to the top of the harness H-1 and H-2 has passed over the pulley P lifting harness H-2, from the balanced position shown in Sketch SL-1.

Each harness H-1 and H-2 is made up of a number of heddles (string or wire) having a loop or eye in the center, see Sketch SL-8, also a loop for mounting the heddle between the sticks of the harness frame, see Sketch SL-5. This assembly or harness permits the individual heddles to be moved freely along the end supports.

The mechanical arrangement of the warp threads required to produce the two sheds shown in Sketches SL-2 and SL-3 is indicated in Sketches SL-6 and SL-7. Each warp thread is passed through heddle wires as indicated in Sketch SL-7. In Sketch SL-6 note the first warp thread on the right (call it No. 1) is passed through the first heddle—mounted in harness H-1. The second warp thread, Sketch SL-6, is passed through the first heddle mounted in harness H-2. The third warp thread is passed through the second heddle in harness H-1. The fourth warp thread is passed through the second heddle in harness H-2. The procedure of passing the warp thread through heddles is known as **Threading the Heddles.** This is accomplished by use of a threader shown in Sketch SL-9, which is inserted through the heddle eye and slipped over the warp thread, then pulled back through the heddle carrying the warp through with it as indicated by Sketch SL-10.

Usually a pattern known as a **Threading Draft** is used to guide the weaver in warping the loom. In Sketch SL-11 the method of expressing graphically the threading procedure described above is indicated. The two horizontal bands indicated by Nos. 1 and 2 represent harness H-1

and H-2. The black squares in each band represent heddles. The position of the black squares in the band indicates the heddles in each harness. This form of notation then yields the following information. All four warp threads pass through both harnesses from back to front of the loom, see direction of arrow, Sketch SL-11. The first warp thread passes through the eye of heddle No. 1, Harness H-1. The second warp thread passes through the eye of heddle No. 1, Harness No. 2. The third warp thread passes through the eye of heddle No. 2, Harness No. 1. The fourth warp thread passes through the eye of heddle No. 2, Harness No. 2.

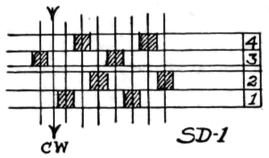
This procedure is repeated and indicated in the draft by extending the bands and filling in the black squares progressing to the left.

Again refer to Sketch SL-1, which shows the four warp threads threaded through the heddles in harness H-1 and H-2. Harness H-1 is supported by ropes attached to each end which are carried over pulleys P and fastened to harness H-2. Refer to Sketch SL-5 for the arrangement of the ropes which attach the treadles to the lower stick of each harness. This tie-up between harnesses and treadles is indicated in Sketch SL-1.

By tramping on treadle I, Sketch SL-2, the harness H-1 and H-2 are both shifted from their original position. So long as weight is applied to the treadle the harnesses will remain in the position shown in Sketch SL-2. Note the No. 1 warp thread is down and the No. 2 warp thread is up, also the passage of the warp thread is indicated in the shed, Sketch SL-2. The shed is changed by pressing down treadle II. This change is indicated by Sketch SL-3. Note the No. 2 warp thread is down and the No. 1 warp thread is up. Sketch SL-4 indicates the position of the weft thread through the two sheds. The warp threads have been numbered to show the position with respect to the weft. The No. 1 warp thread is below the weft in the first shed indicated and above it in the second shed. All the warp threads numbered 1 in our **Draft** are controlled by the treadle I since they are operated as a single thread by means of the harness. Likewise treadle II controls all No. 2 threads.

This simple mechanical device introduced by the Spaniards for making and changing sheds is still used for plain cloth weaving along the Rio Grande.

The procedure for weaving double width cloth on a narrow loom described and illustrated by the photographs in the foregoing pages may well be reduced to a more tangible form for those who weave. The loom set-up is essentially the same as the Spanish colonial type described on page 246. A second set of two treadles, two harnesses (counterbalanced are added to the loom already equipped with two treadles and harnesses. See Sketch SD-1. These harnesses are mounted behind the original set and the additional treadles are placed on the left of the first pair. These treadles number from right to left. The **Draft** for this double width cloth follows.



SD-1

SD-2

The treadles in the set-up are directly connected to the corresponding harnesses, No. 1 treadle to No. 1 harness, No. 2 to No. 2, No. 3 to No. 3, and No. 4 to No. 4.

The treadling draft is indicated in illustrations SD-1, which shows that the first warp thread passes between the heddles in Nos. 4, 3 and 1 harnesses, and through the heddle in No. 2 harness. The second warp thread passes through the heddle in No. 4 harness, also between the heddles of the 3-2-1 harnesses. The third warp thread passes between the heddles of 4-3-2 harnesses and threads the heddle in No. 1 harness. The fourth warp thread passes through the heddle in No. 3 harness and between heddles in 4-2-1 harnesses. This manner of threading repeats for the width of the loom in the order of harnesses 2-4-1-3. An extra warp thread is passed between the heddles of all four harnesses between the last two warp threads, Nos. 1 and 3. See extreme left of threading draft, SD-1. This floating warp thread although it is in the fold at the left hand edge of the double width fabric, becomes the center warp in the finished cloth.

The treadling draft follows. Press down on treadle No. 4. This forms a 3-4 shed (all No. 3 warp threads are down). Pass shuttle from right to left and carry it around the center warp **to the left,** as indicated in the shuttle diagram SD-2. This floating or center warp is marked C. W. in the diagram.

Press treadle No. 4. This forms a 4-3 shed (all No. 4 warp threads are down) that is, the No. 4 threads are on the bottom of the shed. Pass the shuttle to the left. Carry it around the center warp C. W. **to the left.**

Press Treadle No. 2. This forms a 2-4 shed (all No. 2 warp threads are down). Pass the shuttle to the left, carry it around the center warp C. W. **to the right** as indicated in the shuttle diagram SD-2.

Press Treadle No. 3. This forms a 3-4 shed (all No. 3 warp threads are down). Pass the shuttle to the right.

Repeat this treadling procedure and shuttle passing in the order given 4-1-2-3 and include the floating warp thread each time it is encountered. The procedure follows this specification:

Treadle No. 4—Carry shuttle to the left and around the C. W. on the left.

Treadle No. 1—Carry shuttle to the right.

Treadle No. 2—Carry shuttle to the left and around the C. W. on the right.

Treadle No. 3—Carry shuttle to the right.
Repeat.

WASHING AND SCOURING WOOL

Cleaning Fleeces and Pelts

I. Pick out dirt and sticks by hand and shake out loose foreign matter.

II. Make a soap solution in luke warm water. (a) **Navaho Indian Method**—Shredded roots of yucca yield soft soapy suds. (b) **Modern Home Method**—Make the soap solution with a neutral soap. Any face or hand soap is satisfactory. Soap flakes, Lux or Ivory are excellent.

III. For grease wools, use a scouring solution made by dissolving one ounce of neutral soap (about 1½ cups of soap flakes) and one half ounce of sal soda (one level tablespoonful) for each gallon of hot water. Dissolve fully in hot water. Cool to about 110 degrees to 120 degrees F.

Scouring

Pass the wool through two or three different scouring solutions. Allow the wool to remain in each batch of solution for 20 to 30 minutes. Keep it gently submerged, not stirred, with a paddle or by hand. Squeeze out the water by hand or by passing the wool through a wringer. Don't rub or twist, when the wool is clean, rinse it through two clear waters and dry thoroughly.

Where the wool is on the pelt a convenient method of handling is the following:

1. Cut through the skin with a sharp knife from the flesh side. Cut the pelt up into strips about four inches wide and the length of the skin.
2. Cleanse by the method mentioned above for scouring fleece.
3. Drain by passing the strip through a wringer or squeezing the water out by hand. Considerable moisture may be flung from the strip by swishing it in the air.
4. Dry in the sun.
5. Shear the wool from the skin and it is ready for use.

DYES AND DYEING

The early weavers of home spun wool yarn in the Southwest had the natural colors; white, brown, black, and mixtures of grey and light brown, also Indigo blue. This limited assortment became tiresome and prompted the search for colors to break the monotony of drab striped patterns. Many vegetable dyes were developed from roots, bark, and berries of various plants. The alert Navaho obtained colored yarn by removing it from finished fabrics and reweaving it in blankets of his own design. The priceless Bayetas come from this source.

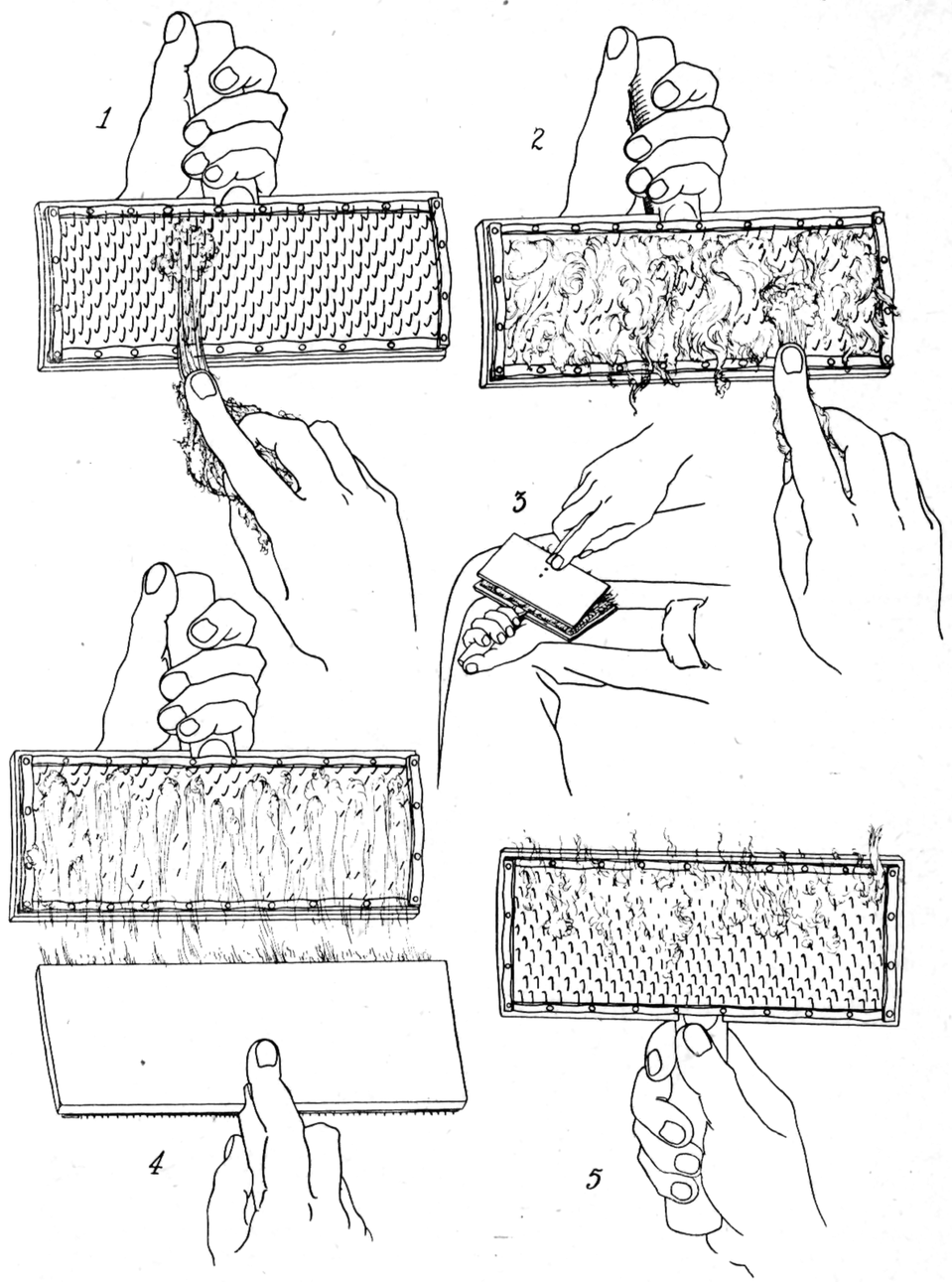
The development of the "Native Dyes, Methods and Formulas" is given in "Navaho Weaving" by C. A. Amsden, see foot note, page 236.

The chemist has aided the weavers of the Southwest by making available aniline dyes in a wide range of brilliant colors. Many shades are available in the series developed for the Batik worker that are entirely suitable for dyeing fleeces and wool yarns.

Interesting mixtures result from carding fleeces of two or more colors together. Also plying yarns of different colors yield pleasing combinations in the woven fabric. These two procedures make available to the craftsman a wide range of colors in the softer tones, obtained with aniline dye stuffs. An excellent reference book is "Dyes and Dyeing" by Charles E. Pellew.

CARDING WOOL

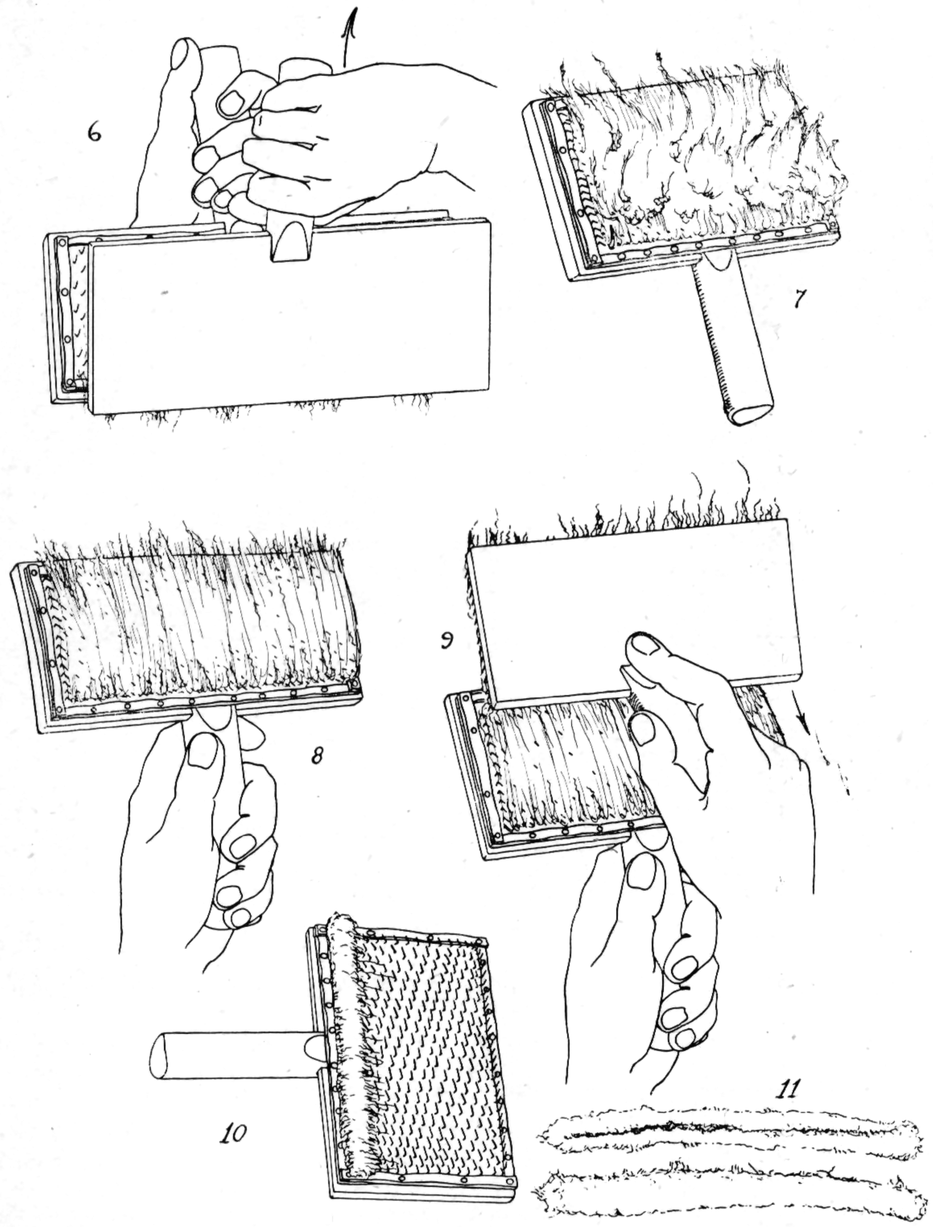
The process of combing and straightening wool fibers preparatory to spinning is known as **carding.** The tools employed are known as ***Hand Cards.** Prior to the introduction of this equipment to the Navahos by the traders they used an improvised card, made by clamping spiny thistles or burrs into a frame. To make a medium or coarse yarn, the fleeces were pulled apart with the fingers (teased), and these fluffy masses twisted into yarn without further preliminary preparation. Some yarn was spun in the grease (as it is called before washing or scouring). In fact, yarn spins



*L. S. Watson & Co., Leicester, Mass. No. 8 for heavier coarse wool stock. No. 10 for cotton and fine wool stock.

more readily **in the grease** than after the natural fat (lanoline) has been removed. It is a commercial practice to restore the necessary oil content to some grades of wool before it is spun. Other grades of wool contain so great an oil content that a portion of it must be removed before it may be readily spun.

Hand Cards are available for both materials, cotton and wool. The manufacturer describes the construction of this equipment and makes recommendation for its care. "The wires are flexibly, but firmly set (in leather), uniformly and accurately pitched, and correctly pointed to prevent



tearing and breaking of the individual fibers. For longest wear and most satisfactory results, shift cards top for bottom as you use them. Store them

face to face away from moisture." A good practice is to keep a bit of oiled fleece between them when not in use.

The process of carding can be performed by a person comfortably seated on a low bench or chair. The procedure is as follows:

1. **Load the card** which is held in the left hand, and rests upon the left knee. The handle points away from the carder as indicated by Sketch 3. Take a small portion of the teased wool (wool fleeces pulled apart with the fingers) and spread it over the **left hand card,** Sketch 1. The appearance of the loaded card is indicated in Sketch 2, page 255.

2. **Comb the loaded card** by drawing the **right hand card** lightly over the **left hand card** as indicated by Sketch 4. Repeat this combing several times. A portion of the fleece will then be found transferred to the right hand card as indicated in Sketch 5.

3. **Reload the left hand card.** This is accomplished by drawing the left hand card across the right hand card as indicated by Sketch 6. The appearance of the left hand card, after the transfer, is shown in Sketch 7. This method is employed by the weavers in the Southwest.

Repeat the combing and reloading twice more. This straightens the strands and the fleece is ready to be taken off.

4. **Remove the carded wool** and form a batt. The loaded card is held in the left hand, Sketch 8 (handle toward the person carding) and the right hand card is held in the position indicated by Sketch 9. The wires in the lower edge of the right hand card are used to lift the wool fibers off the lower card. This is accomplished by merely drawing the upper card across the lower card with a motion indicated in Sketch 9. A large, loosely formed batt may be produced by one stroke of the upper card. However, a more compact batt results when the wool is removed in a few short strokes as suggested by the arrows in Sketch 9. Sketches 10 and 11 show finished batt.

CARDING-MIXED MATERIALS

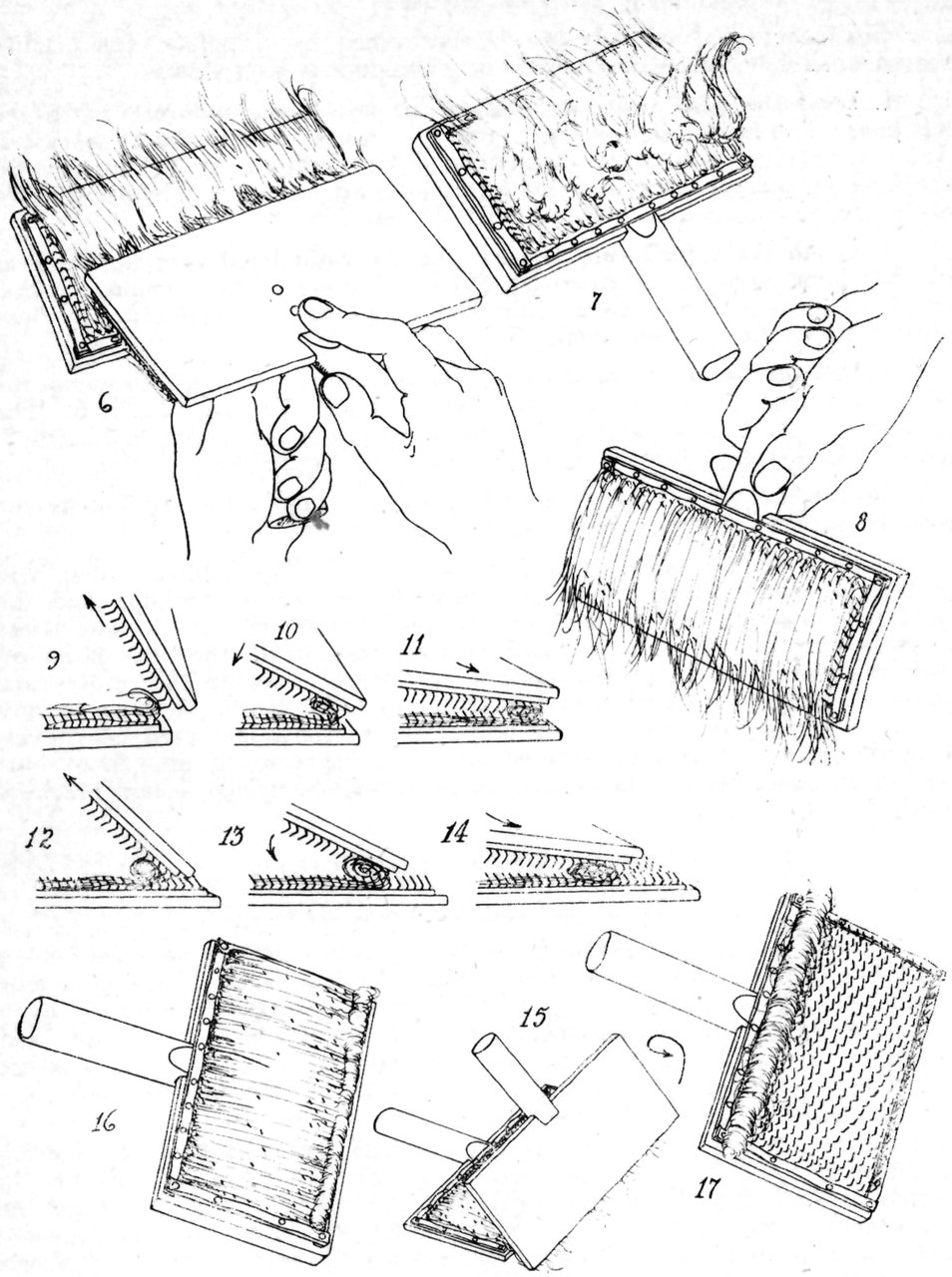
Wool and Angora Goat Hair

Some of the finest Navaho blankets are woven with a yarn containing a mixture of wool and Angora Goat hair. The long fibers of the goat hair permit making a strong, coarse, loosely twisted yarn. The fabric woven with the large size single strand yarn is quite heavy, very soft, and possesses a lustrous silky texture. The method of carding a mixture preparatory to spinning is similar to the procedure described for wool.

1. **Load the card** by placing both wool and goat hair on the card, and combing them together. The portion of the hair and wool mixture adhering to the right hand card is transferred to the left hand card, as indicated in Sketch 6, page 258. After the transfer is made, the left hand card has the appearance shown in Sketch 7. This combing procedure should be repeated three or more times if necessary to straighten the fibers. Sketch 8 shows the appearance of the straightened fibers.

2. **Remove the card mixture** as indicated in Sketches 9 to 14. The long fibers extending over the edge of the lower card, are folded back upon the card as indicated in Sketch 9. Downward pressure applied with the upper card is indicated by the arrow shown in Sketch 10. The pressure is carried forward as indicated by the arrow in Sketch 11, before removing the upper card. This downward and forward pressure compacts the fibers together preparatory to rolling the bast, the name applied to a roll of long fibered material.

CARDING
Mixed Materials



The series of Sketches 12 to 14 is a repetition of the procedure indicated in Sketches 9 to 11. The process follows:

1. Lift the roll at the outer edge, and fold it over the straightened fibers held in the lower card.

2. Compress the roll by a downward and forward pressure applied with the upper card, as indicated by the arrow in Sketch 15.

The appearance of the lower (left hand) card with the bast started is indicated by Sketch 16, while 17 shows the tightly rolled mixture after the lower card has been cleared and just prior to removing the bast.

SPINNING WOOL

The art of twisting fibers into threads is very old. The finding of spun threads, remnant fabrics, and the tools used for spinning over widely scattered areas, is evidence that spinning and weaving was a major activity of prehistoric man. In fact the basic spinning mechanism, a weighted spindle or whorl, devised in the earliest ages, continued to be used (with but slight modification) for many centuries by civilized man. The art of spinning retained its primitive aspects considering its universal practice, longer than any other primal employment. This contentment with the status quo ceased about the middle of the eighteenth century. The effort to improve the art has resulted in the development of machinery which for "greater variety, delicacy of action, manifold productive capacity" has not been excelled in another mechanical industry.

The implements employed in spinning—the weighted spindle or whorl—were selected for the particular kind of fibers to be spun. Sketch 1, page 262, represents the general type. Size and weight had to be adjusted to suit the strength and *delicacy of the thread.

Flax and other long fibered basts were spun by drawing out bunched strands from a supply mounted on a support known as a distaff. This was held under the left arm of the spinster. Short fibered material—wool—was spun from carded batts or rolls. This primitive operation consisted of:

1. Attaching a few strands of twisted fibers to the spindle, as shown in Sketch 3, page 262.

2. Rotating by rolling with the hand against the thigh, also twirling between thumb and fingers of the right hand. When the weight of the spindle was sustained by the strength of the thread, it was unnecessary to support the lower end. However, when support was required, the lower end of the spindle rested in a concavity in the ground, or a potsherd or shell sometimes was used.

3. Drawing out fibers into a strand of uniform diameter the tension required was obtained by pulling between the hands.

4. Twisting the stretched fibers, until strength and size was obtained.

5. Winding the twisted strand upon the spindle. Usually about an arm's length was twisted and wound on the spindle at one time.

A skillful spinner can make yarn of uniform size, strength and fineness comparable to the best produced by modern machinery.

SPINNING WOOL
Navaho Indian Method

In the methods and tools used by the Navaho for making yarn out of wool, we find equipment and procedure identical to those developed and used by spinners and weavers in the pre-spinning wheel era.

Wool fibers, separated by pulling them apart with the fingers (a process known as teasing) are partially cleaned. Matted dirt, burrs and other foreign matter are removed during this fiber stretching process.

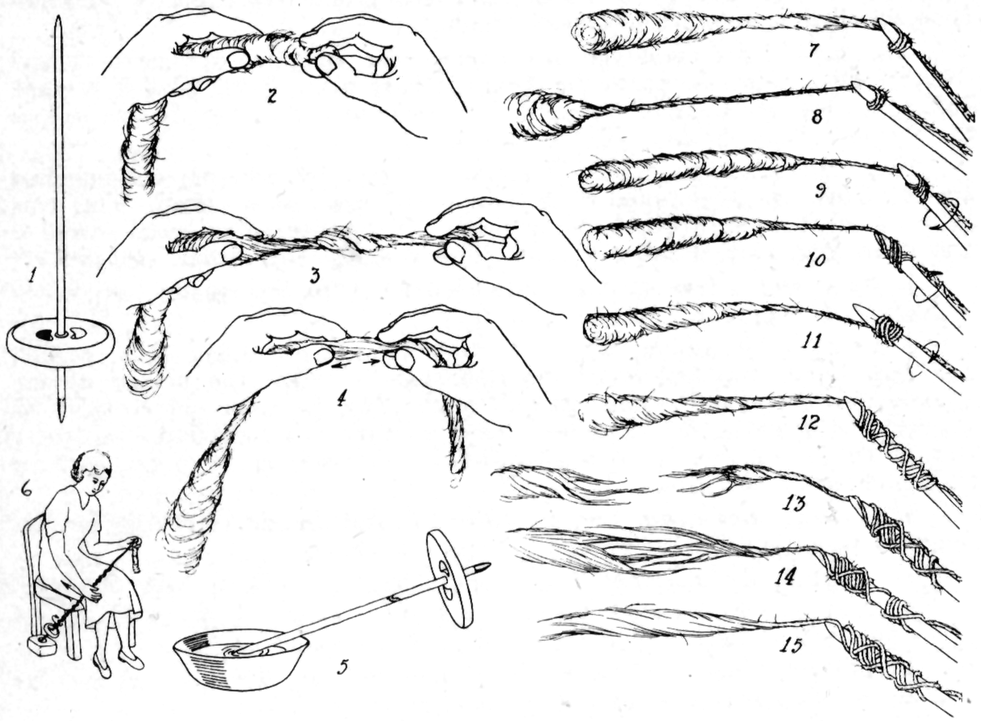
The elongated wool fibers are further straightened by combing, a process known as **carding.** See pages 255 to 258 for detail in the carding procedure. The product of the cards is a roll of wool known in our own Southwest as a **batt.** The early English name for this carded wool roll was **rolag.**

The primitive twisting device is the **whorl** (a weighted spindle), which

*India muslins (Dacca) were made from cotton threads so fine that one pound contained a length of 250 miles. The spindle used, made of bamboo about the size of a small darning needle, was slightly weighted with a whorl of clay. The weight of the spindle required support and it was twirled with the lower end resting in a hollow shell.

is revolved by twirling with the fingers or rolling on the thigh. See page 262 for the English method of spinning wool yarn with a whorl.

Navaho spinners use a whorl (**Pe-te-ze**), and the Spanish colonists had their **Malacate.** Both are similar to the twisting devices of antiquity. A wooden shaft about 20″ long is weighted with a wooden disc 4″ or 5″ in diameter. The disc is held in place by friction, and mounted about 4″ from the lower end. See Sketch 1. The Navaho method of using the **peteze** follows:



1. Attach a piece of strong wool yarn to the spindle just above the whorl, and build up a cone-shaped section of yarn covering, as shown in Sketches 4 and 5, page 262. Carry the free ends of yarn along the spindle. About an inch from the end wrap the yarn around that tip, three or four turns. Sketch 7, above.

2. Permit about 3 inches of yarn to extend beyond the tip of the spindle. Untwist the yarn, fan out the fibers as indicated in Sketch 2. Grasp the untwisted yarn in the right hand between thumb and forefinger.

3. Stretch and fan out the tip of the batt, see Sketch 3, and place the ends of the yarn and wool batt together. Hold their junction (yarn and batt) tightly between the thumb and forefinger of the left hand.

4. Rotate the spindle by twirling it (clockwise) slowly between the fingers of the right hand. As the twist accumulates in the yarn, slide the left hand away from the junction between yarn and wool batt, permitting the twist to enter the batt.

5. Keep the spindle rotating by drawing the hand across it and against the thigh, see Sketch 6. The Navaho spinner sits on the ground, and rotates the spindle with the lower end supported by a hole in the ground, or resting in a small piece of pottery. Meanwhile the batt is pulled with the left hand and twisted yarn forms as the strand of twisted fibers slips off the end of the spindle, see Sketch 8. After an arm's length of yarn is spun, the rotation of the spindle is stopped by grasping it with the right hand. The new length of yarn is coiled around the spindle as indicated in Sketch 5, page 262.

6. Splice a new batt into the end of the last one by spreading the ends out into a fan, see Sketches 13-14-15. Overlap the ends of the wool and twist together before applying tension to the new batt.

7. Repeat these two processes of twisting the stretched batt forming the fibers into yarn, and of winding the yarn on the spindle. The yarn slips off the spindle tip as indicated in Sketches 9-10-11. Sketch 12 indicates the accumulation of the yarn on the spindle.

8. Remove yarn from the spindle and roll into a ball for use in weaving rugs. Yarn intended for use as warp should be spun a second time to give it greater tensile strength.

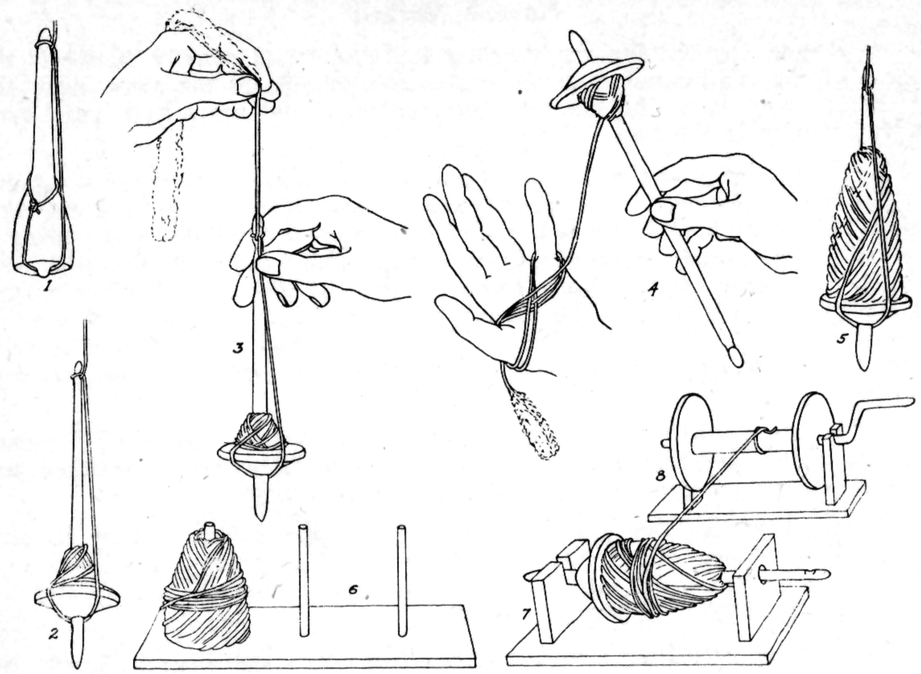
SPINNING—PRIMITIVE METHOD

English

The primitive spindle and whorl used in the British Isles is shorter than the one used by the Navaho spinners. Some of these spindles are not more than 9 or 10 inches in length, and are made of heavy wood, tapered as indicated in Sketch 1. This type does not have a detachable whorl. (It depends, however, on the increased diameter and weight near the base to serve the same purpose. The spindle shown in Sketch 2 is more typical. The manner of using the shorter spindle also differs slightly from the Navaho procedure, described on page 260. The anchor yarn is attached above the whorl, Sketch 2. A cone-shaped covering of yarn is wound on the spindle just above the whorl. This forms a core and the base for accumulating yarn as it is spun. The yarn is carried from this cone over the edge of the whorl under the spindle shaft, below the whorl, as indicated in Sketch 2. Tension is placed on this anchor yarn, which is held taut by friction at the points where the yarn bights into the edge of the whorl. The free end is held snugly against the spindle until a half hitch is formed near the top, and the loop slipped into the groove made to receive it.

The English and Navaho methods of using the spindle are similar. The Navaho spinner invariably sits on the ground, and rests the spindle in a

* The spindle illustrated is made from an arrow shaft. The conical point of the metal pile, when resting in a concavity in a block of wood, permits the shaft to rotate freely with a minimum of friction.



concavity, either in the ground or piece of pottery, while the English method permits the spinner to stand or walk about while carrying on the process of spinning.

The end of the anchor yarn and wool batt are joined as described in paragraph 3, page 260. The spindle is rotated as indicated in paragraph 4, page 261. When sufficient twist has entered the wool fibers drawn from the batt, see Sketch 3, the right hand is slipped upward to the top of the newly made yarn. Another outward twirl of the spindle keeps it whirling in mid-air. More wool is pulled out of the batt by separating the hands and the twist is permitted to enter the strands of wool fibers as described above. This is repeated and the spindle descends with each new length of yarn added. The spinning continues until the spindle touches the ground. The newly made length of yarn is then placed on the spindle above the whorl. This is accomplished in the following manner:

1. Remove the half hitch from the notch in the spindle and place the spindle where it will remain stationary.

2. Wrap the yarn around the thumb and little finger of the left hand as indicated by Sketch 4.

Grasp the spindle with the right hand and transfer the yarn (under sufficient tension) from the left hand to the core of yarn on the spindle. The figure eight criss-cross wrapping forms a satisfactory cone for accumulating the newly spun yarn.

Repeat this process until the space on the spindle is filled. The combined weight of yarn and spindle may easily produce greater tension than is desired, so the increasing weight must be carefully controlled. See Sketch 5 for the appearance of the loaded spindle.

3. Unload the spindle by slipping the cone of yarn off and place it on a stationary spindle, see Sketch 6.

The use of the yarn will determine the most convenient form for storage or accumulation.

The yarn produced in the spindle rotated clockwise as described above is a left hand twisted single strand. It may be used for knitting or weaving fabrics, as it comes from the spindle.

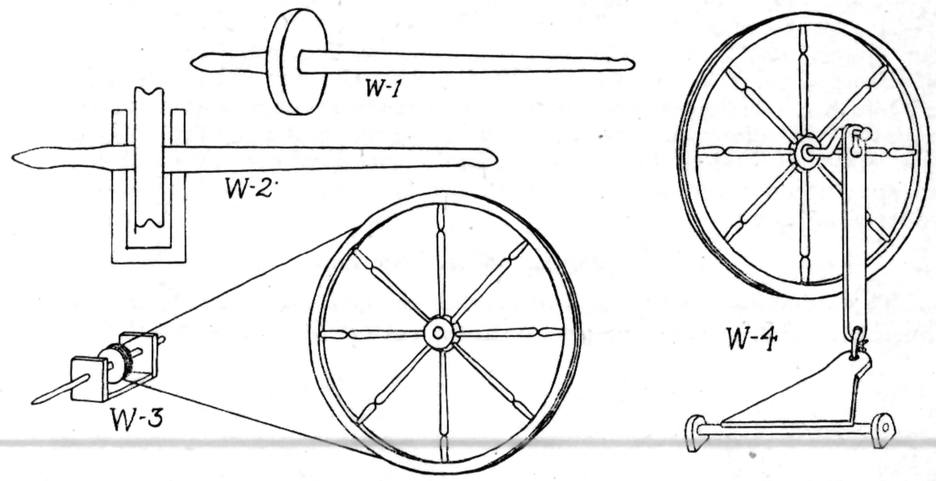
The Navaho weavers use some coarsely spun single (ply) strand yarn in their blankets for weft. They spin the warp yarn a second or third time to give it sufficient strength for the purpose. See page 258 for notes on yarn handling.

In case the yarn does not come off the spindle readily, it may be removed by mounting the spindle in supports, see Sketch 7, and winding it directly on a spool as indicated by Sketch 8.

SPINNING

Bobbing Wheel

The transition from the weighted spindle twirled between the fingers to the spinning wheel was effected in two stages. The spindle was mounted on a horizontal support—See Sketch W-2—and a groove cut in the whorl. The spindle was connected by a twisted strand of fiber, linen, or cotton,



belted to a large diameter wheel. Sketch W-3 depicts this mechanism which was operated by turning the large wheel with the right hand. The filaments of fiber were attached to the spindle in the manner indicated for the finger twirled spindle described in the foregoing paragraph and drawn out by the left hand. The twisted strand was coiled upon the spindle by holding it at right angles to the revolving spindle. This improvement was known as the **bobbing wheel.** This mechanization served spinning for nearly 500 years, from the fourteenth to the nineteenth century. The **bobbing wheel** served to make a loosely twisted strand of yarn known as a **roving**, which was upon second spinning further stretched and twisted into a finer yarn.

According to a record of 1533 a treadle was applied to the driving wheel as indicated in Sketch W-4. This improvement added foot power to the mechanism, freeing both hands for manipulation of the fibers.

The next improvement was the detachable spool or **bobbin,** and the device known as the **flyer,** which twists the yarn before winding it on the spool. This device was developed during the 16th century and the machine embodying this improvement, known as the **Saxony Wheel,** changed spinning from an intermittent to a continuous operation.

The procedure of spinning with the hand operated spindle described on page 262 consists of two operations:

1. Twisting the fibers into a strand of yarn.

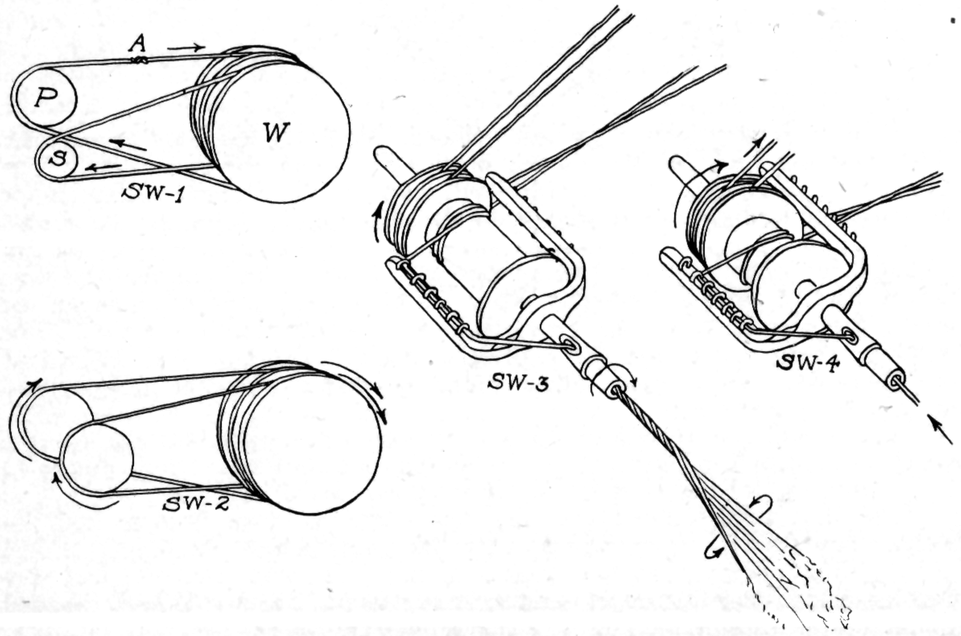
2. Winding the yarn upon the spindle.

The length of the yarn strand ranges from an arm-length to the height of the person spinning, depending on the method employed. The Navaho spinner sits while spinning, and the spinner using the primitive English method may stand or walk while spinning. By either method it is necessary to stop spinning after twisting a length of yarn, while performing the operation of winding the yarn on the spindle. Both of these operations were expedited by the invention of the hand power Bobbing wheel, see page 263, which was further improved by the addition of a foot treadle. Longer lengths of yarn could be spun at one time and more rapidly wound upon the belt driven spindle. Yet the spinning operation remained intermittant until both operations could be performed simultaneously on the ingenious Saxony wheel (see page 266) which increased the spinner's output and reduced fatigue to a minimum.

Two types of wheels embodying the principles of the Saxony wheel are in use, one a horizontal type and the other vertical. Yarn of standard quality may be spun on each type. The vertical type occupies the smallest floor space, also has a drive wheel of the smallest diameter. The size of the drive wheel controls the spinner's output of yarn, also the amount of foot action. The larger horizontal type wheels are operated with the least amount of treadling and the output is estimated to be a third more for the same effort expended than in operating a small wheel. A skillful spinner can spin about three ounces of yarn per hour on a wheel of good design properly adjusted.

Spinning Wheel Method

The spooling and twisting mechanism of the Saxony wheel is illustrated. The drive cord, usually made of strong cotton thread, is applied as indi-



cated in Sketch SW-1. Start at point A, carry the drive cord over the top and around drive wheel W, and on to the bottom of spool pulley S. Carry the cord under and over the top spool pulley S, and return to the drive wheel W. Again carry the drive cord around the wheel W, and on to the spindle pulley P. Carry it under and over the top of spindle pulley P, and return to point A. Join both ends. A surgeon's knot (see page 368 for method of tying) is suitable. This joint should be small in diameter and the ends of the cord cut off close to the strand.

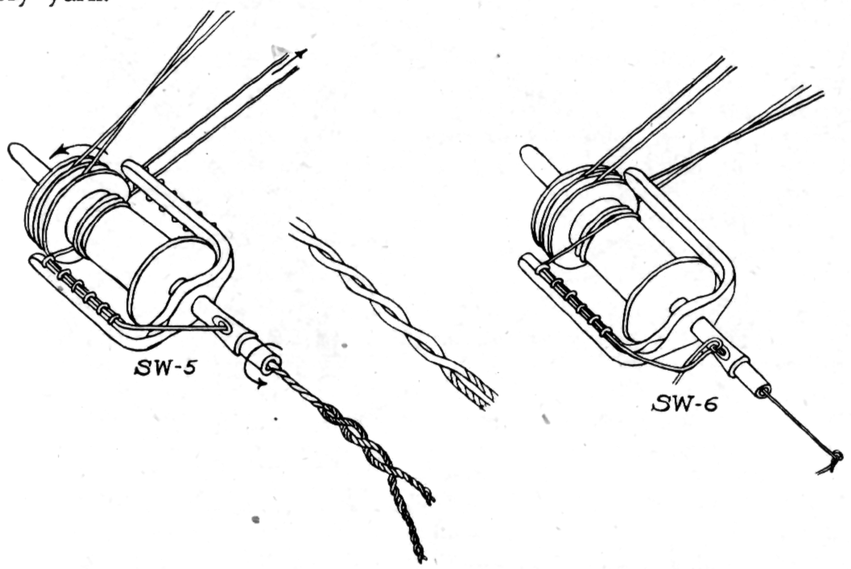
Two types of work are done on the spinning wheel.

1. **Spinning**—twisting and winding single strand yarn on the spool. Rotation of wheel, spool, and spindle is clockwise, Sketch SW-2. The wool fibers are twisted to the left, as indicated in Sketch SW-3.

2. **Plying** or folding yarn is accomplished by twisting two or more strands of yarn together into a single strand. A strand formed by twisting two single strands of yarn is known as ***two ply.** Two strands of two ply yarn twisted together makes a **four ply** yarn.

The **two ply** of **left hand twisted** single strands is twisted to the right. The **four ply** of **right hand twisted two ply** strands is twisted to the left. "Fancy yarn is made by twisting together thread of different counts, colors, materials, or twistings, at regular or irregular tensions in the same or opposite directions."

Rotation of the drive wheel, spool and spindle is counter clockwise, see Sketch SW-5, which places a **right hand twist** in the two strands of single ply yarn.

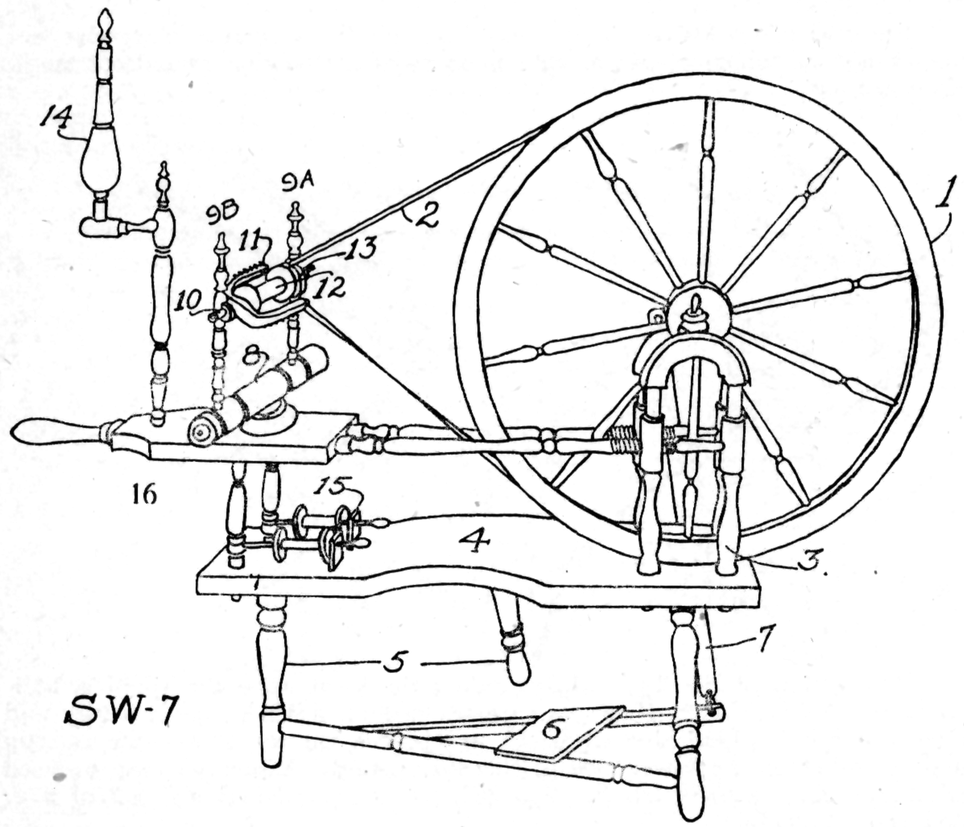


The action of the flyer while guiding the yarn upon the spool is indicated in Sketch SW-4. The yarn passes around a **heck** (guide wire) and over the spool. Two sets of hecks are placed on the flyer—one on top and the other on the lower side of the flyer prongs. Either set may be used while spinning—see Sketch S, page 267, for the construction detail of flyer and sets of hecks.

*Sewing cotton is made in two to six cords from various size single strands. Two cord (doubled, folded, or plied) is made from two cords twisted in opposite directions to the single. Six cord is made from three two folded cords—twisted into one.

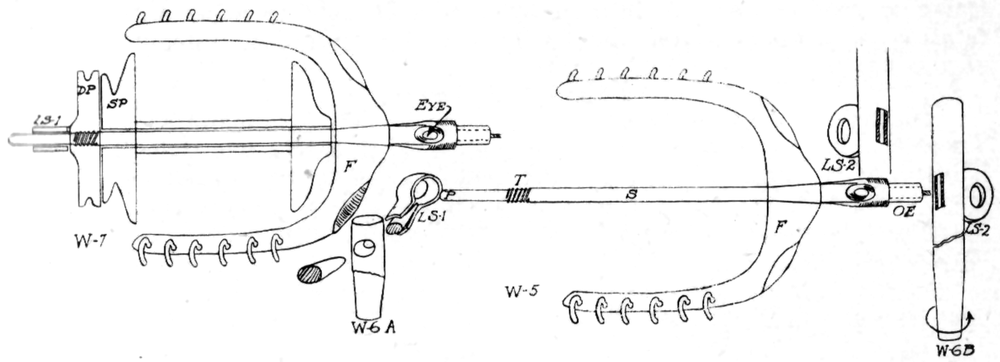
The spinning wheel illustrated in Sketch SW-7 is of English origin. It is well designed and easy to operate for either the operation of spinning or plying yarns. The parts are numbered as follows: 1—Drive Wheel; 2—Cord Belt; 3—Wheel Supports. In this particular spinning wheel the supports may be adjusted to give proper wheel alignment by rotating either of the threaded rod—connecting the front supports with the "Mother of All," the name given to the assembly composed of the parts 8 to 13; 4—Bench; 5—Bench Legs; 6—Treadle; 7—Connecting Rod; 8—Cross Bar; 9—Spindle Supports; A—Rigid; B—Movable; 10—Spindle; 11—Flyer; 12—Spool; 13—Drive Pulley; 14—Distaff and Support; 15—Spool Rack; 16—Tension Screw.

The craftsman who may have facilities and the inclination to construct a wheel of good proportions will find the following data useful. The circumference of the drive wheel from which Sketch SW-7 was made, measures 79⅜" at the bottom of the grooves. The circumference of the spindle pulley measures 6¼" and that of the spool pulley 4¾". This means that one turn of the drive wheel spindle makes 12.7 turns and the spool revolves 16.71 times or nearly one third faster than the spindle (1.31 is the ratio).



The construction of the twisting and spooling mechanism is detailed in Sketches W-5-6-7. The spindle, Sketch W-7. is mounted in a horizontal

position, and supported by two pieces of leather, LS-1-2. These leather supports or bearings are secured to vertical wooden standards by wooden wedges—see Sketches W-6—A and B. The standards are cylindrical in shape and the tapered lower ends fit into cone-shape holes in a wooden base. The spindle is readily removed or replaced, as is necessary when changing spools or bobbins. This is accomplished by rotating one of the standards sufficiently to permit slipping the spindle out of outer leather bearing LS-2 (for removal of the spindle) or over the outer end of the spindle after first inserting the end in the inner or LS-1 bearing.



The Metal Spindle, S, refer to Sketch W-5, carries a **wooden flyer,** F, rigidly attached to the outer end. The spindle is a round rod somewhat tapered from the outer end, OE, to the point P. It is reduced to a rectangular cross-section where it passes through the **wooden flyer,** F, which permits this device to be rigidly attached by wedges. Beyond the flyer is an eye, which connects with a hole drilled in the (Sketch W-7) outer end of the spindle. Into this opening through the outer end (OE) of the spindle, the twisted fibers of thread pass. After emerging from the eye the thread is carried along one prong of the flyer, around bent wires known as **hecks,** the purpose of which is to guide the thread evenly upon the spool. Several **hecks** are provided, and during the process of filling a spool the thread must be shifted from one **heck** to another to insure equal distribution.

In Sketch W-5 the drive pulley DP, spool pulley W-7, and spool have been removed. It should be observed that the portion of the spindle encompassed by the prongs of the flyer is the spool space. The spools are slipped over the end of the spindle and must revolve freely on this portion of the spindle as an axle. Just beyond the spool space is a threaded section. T, which screws into a nut set in the hub of the drive pulley DP. This threaded portion carries a left hand thread. The twist in yarn or thread produced by a spindle rotated clockwise is known as a left hand twist.

The amount of twist required varies with the kind of material. Each turn of the spindle and flyer twists all fibers about a common axis, once for each revolution.

The **spool** revolves at a faster speed than does the **flyer** and is driven by a separate cord belted to the larger drive wheel.

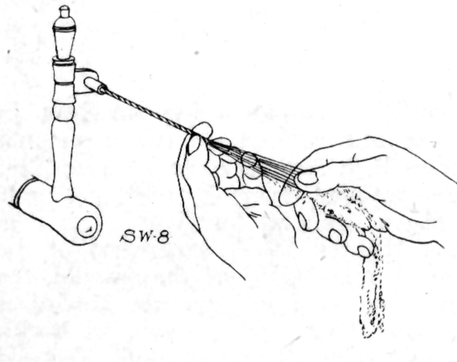
In the 17th century a second similar spindle and flyer were mounted on the same standards. The dexterous spinner could then manipulate a thread with each hand. The addition of the extra spindle marked the last improvement in the hand spinning of yarn. Inventions followed which revolutioned the art of spinning and made it a part of the present factory system.

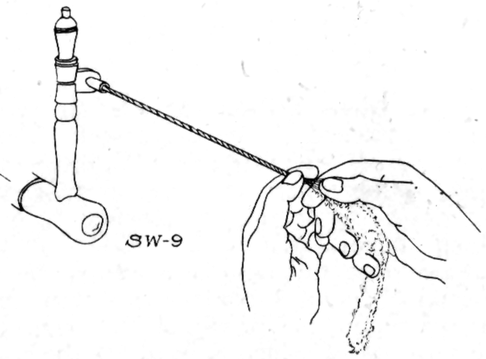
Operation of Wheel

The wheel should be kept clean and slightly oiled (olive or machine oil) to insure freedom of rotation for all moving parts. A well designed and truly balanced wheel operates so smoothly that fatigue is not experienced after hours of spinning. It is important to master **treadling** before attempting to spin. The drive wheel is turned by hand until the connecting rod (part 7, Sketch SW-7) has begun to descend, then pressure on the treadle should be applied with the foot. Slight pressure only is required for smooth rotation of the drive wheel. Since this pressure is intermittent, it must be applied at the proper time and with the proper intensity. This foot pressure is best applied with an ankle-toe action, rather than a tramping foot motion. A little practice is necessary to acquire a smooth rotation of the wheel continuously in the same direction without the aid of the hands.

Spinning Procedure

Mastery of wheel treadling is essential before attempting to spin. There are four operations performed with the hands and one with the foot. These are performed in such rapid sequence as to be considered almost one operation. Yet for purposes of visualizing these almost simultaneous operations which are performed while treadling the wheel we will list these motions as follows:


SW-8


SW-9

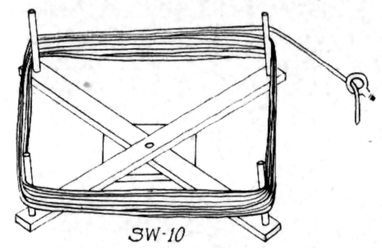
1. Hold the yarn together between the thumb and forefinger of the left hand to control the twist and transmit it into the batt, as required, Sketch SW-8.
2. Elongate the wool batt by pulling with the right hand.
3. Permit the twist to enter the stretched fibers by moving the left hand toward the right hand, Sketch SW-9.
4. Permit the strand of yarn to be drawn through the spindle and wound upon the spool. Both hands may appear to be moved closer to the spindle as the yarn is drawn through the spindle.

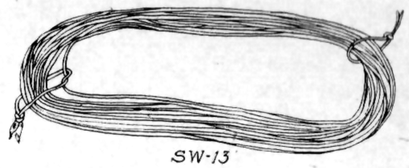
Actually, when the process of spinning is mastered, the tension on the yarn, as it is drawn through the spindle to the spool, keeps the left hand almost in one position.

Handling Yarn

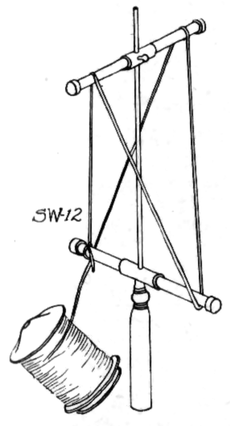
The filled spools of spun yarn are removed from the spindle and stored on a spool rack. The single strand of yarn may be required for weaving in which case it may be transferred to a ball or skein from the spool. Yarn for knitting should be doubled or plied and this may be done by placing two spools of yarn on the spool rack of the spinning wheel and fed into the spindle, revolving counter clockwise onto another spool. Two, three or even four yarns may be twisted into a single strand and wound on a spool by keeping the single strands separated as they leave the spool rod until they enter the spindle. See Sketch SW-10. Yarn to be

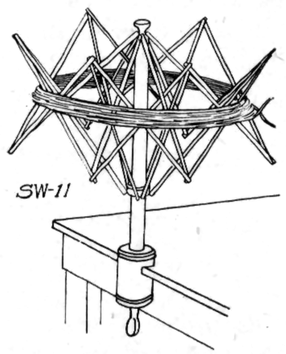
Handling Yarn

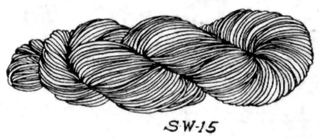

SW-10


SW-13


SW-14


SW-12


SW-11


SW-15

skeined may be wound on a **skeiner,** see Sketch SW-10, a **table swift,** Sketch SW-11, or a **Niddy-Noddy** shown in Sketch SW-12. Attach one end of these yarns to the swift and turn it by hand, guiding the yarn into the V-shape groove formed by the collapsible arms. When sufficient yarn has been placed on the skeiner, collapse the arms to a small enough diameter to permit slipping the skein off. Tie the ends around the skein as shown in Sketch SW-13.

Before removing a skein of yarn from the mechanism on which it is formed the ends should be tied and the loops secured. A method commonly used is illustrated by Sketch SW-13. Another device for keeping yarn in skeins from becoming tangled is indicated in Sketches SW-14 and 15. The procedure is to twist the elongated skein into a roll as shown in Sketch SW-14 and then pass one end through the other as indicated in Sketch SW-15.

The **Niddy-Noddy** also is a support for winding yarn into a skein. See Sketch SW-12 for the construction detail. This device is rotated in the hand and the yarn is wound around the cross arm as indicated in the sketch. When sufficient yarn has been placed on the supports the upper one is loosened and the skein removed. The ends of the yarn are tied to secure the skein as indicated in Sketch SW-13.

An elongated coil which will pass through the shed of a primitive Navaho loom, may also be used when making "finger woven" designs in plain cloth weaving. The method of forming this coil, or "tamale" as it is sometimes called is indicated in Fig. 1, page 270, Sketches 1 to 6. The yarn may be pulled from this coil as needed and passed through the shed with the fingers without a shuttle stick.

Handling Yarn

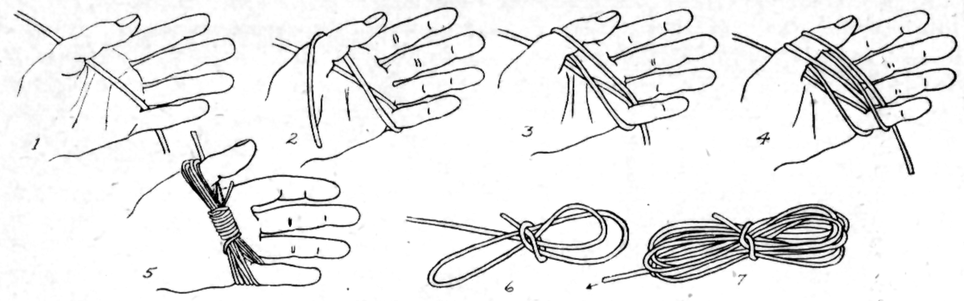
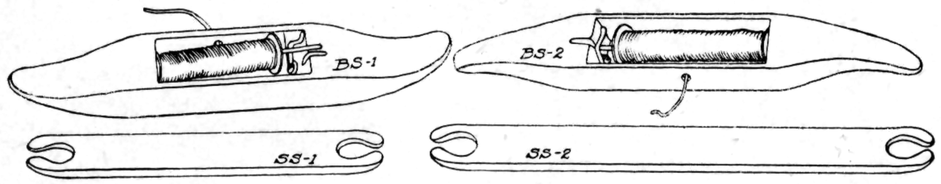


Fig. 1

Shuttles Stick and Boat Type

The Sketches BS-1 and BS-2 show a boat shuttle in which a spool is used. Sketches SS-1 and SS-2 are shuttle sticks on which the yarn is wound.



Warp Beams

Three styles of warp beams are used today. Each has its advantages and disadvantages. Loom builders would do well to design their warp beams, permitting the universal feature of adaptability to any of the three styles.

1. **Roller Type Warp Beam.** The original type of warp beam is the plain roller, on which the entire warp is wound at one time. The warp for this type of beam is **assembled on pegs** which are mounted on a frame, known as a **warping board** or on a revolving reel. The warp accumulated on either a warping board or reel is removed by the chain method. After securing the "crosses" and inserting the lease sticks it is ready to be wound on the warp beam.

2. **The Sectional Warp Beam.** Time is saved when warp is wound on a section of the beam at one time. This method requires a spool for each thread needed to fill one section of the beam. A section may require 24 to 60 threads and as many spools will be necessary on the spool rack. These threads are guided onto the section by passing them through holes drilled in a piece of metal. This guide keeps the thread side by side as they pass over the beam.

3. **Spooled Warp** Manufacturers have prepared warp on spools, 30 to 60 ends and lengths of 10 to 20 or more yards, per spool. These spools are perforated with a ½" hexagonal shaped hole, and require a ½" hexagonal rod for their support.

The first requirement of a warp beam to accommodate any of these methods of warping is that it be equipped with a ½" hexagonal rod. **A single roller,** at least 3" in diameter may be easily constructed from two boards each grooved to fit the hexagonal rod. These halves should be glued and screwed together, then slipped over the rod and turned in a lathe. This beam does not necessarily need to be round. It will serve equally well if it is also hexagonal in shape.

Spooled Warp on metal spools may be used on the metal beam, which is selected to fit the perforations in the spools.

The measuring wheel, Sketch F, Fig. 2, is made on a wooden disc 11⅝" in diameter. The edge of the disc may be hollowed to a depth of 1/32" or a diameter of 11-9/16". This shallow groove is sufficient to keep the thread in place. A bicycle revolution counter is mounted on the base, see Sketch F. A row of finishing nails is set to engage the click on the counter shaft. This counter registers two revolutions of the disc for each tenth of a unit on the indicator. Twenty revolutions of the disc move the indicator one unit. This gives a measurement of 2 yards for each tenth of a unit indicated, and 20 yards per unit on the counter. A ⅜" iron pipe serves as an axle for the wheel. One end of the pipe is attached to a pipe flange, while the other is supported by a 2" pine block. Friction is reduced to a minimum by inserting two ball races, setting one in each side of the 2" block.

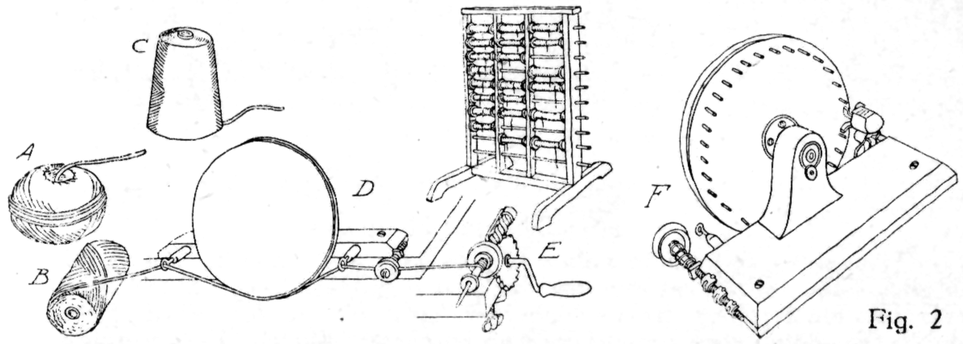


Fig. 2

Another type of counter to indicate disc revolutions, known as a "click counter" may be readily constructed. Drive one finishing nail into the disc near the edge. Attach a piece of thin flexible sheet metal to the base, permitting it to extend over the edge far enough to engage the nail head. The metal must be flexible enough to permit the nail to pass by and return to its horizontal position. Each time the nail strikes the metal it makes a click. These must be counted. One click per revolution is one yard.

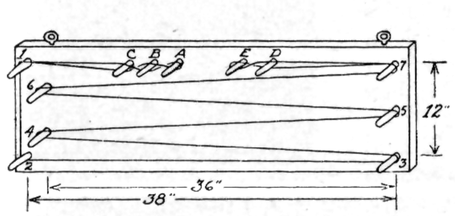
Spool Rack

As soon as the predetermined quantity of warp has been wound on a spool, it is removed from the winding machine and placed in a spool rack. See sketch for type of spool rack. Fig. 2. The number of spools needed for warp is governed by the type of warp beam on the loom.

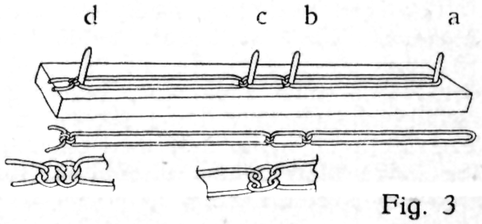
Preparation of Warp for Roller Type Beam

It is assumed that the number of warp threads per inch has been determined and that enough spools have been filled and placed on the spool rack, the necessary yardage to make a bolt of cloth of the desired width and length.

It is necessary to accumulate a certain number of warp threads of a predetermined length. In Fig. 3, Sketch A, a simple form of Warping Board is shown, which may be placed on the wall, supported by screw eyes in its upper edge. The dimensions should be increased to give a suitable length to the warp for a large loom. A warp only six yards long (suitable for a small table loom) may be made on a warping board of the dimensions given.



A



B

Fig. 3

Use of Warping Board

A single thread applied to the board a sufficient number of times would produce a warp of any specified width. The path of a thread from a spool, cone or ball in traversing the board is indicated. Tie the end to peg A, Fig. 3, carry it over peg B, under peg C, around pegs 1 to 7, over peg D, under peg E, around each numbered peg back to peg 1. Then carry it over peg C under peg B, over and around peg A. This process, if continued, will need to be repeated as many times as there are single warp threads in the loom width.

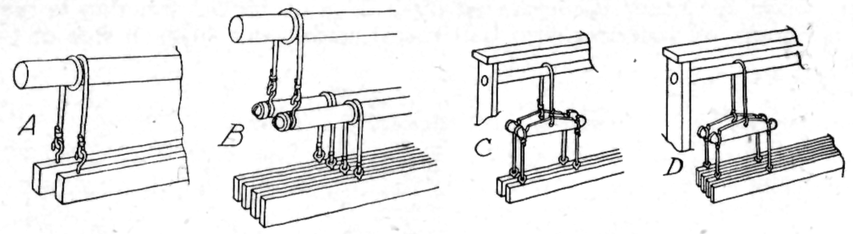


Fig. 4

Counter-Balanced Harnesses

Two styles of counter balanced harnesses are shown in Fig. 4. Sketch A shows the **roller type** support, for a two harness loom. Sketch B shows two additional rollers, from which four harnesses are suspended. Sketch C shows the **sliding rope** support for two harnesses. Sketch D shows the use of a "horse," a center suspended lever in a four harness loom.

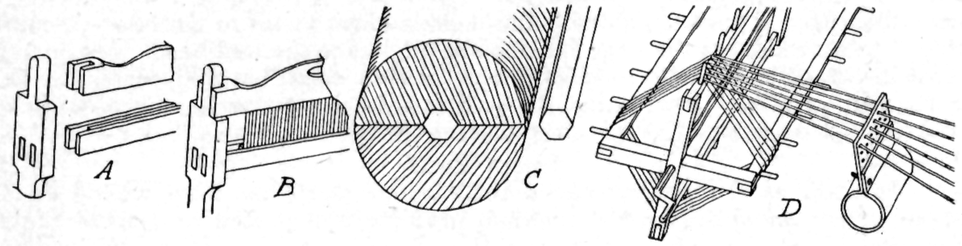
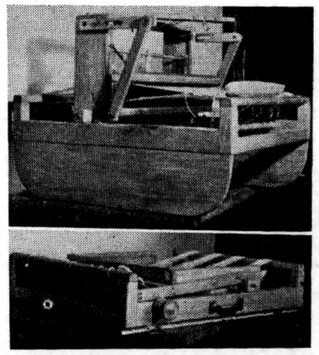


Fig. 5

Cord Heddles

Cord Heddles are readily constructed on a "jig" similar to Sketch B in Fig. 3. Loop the cord over peg A and tie a square knot below each peg as indicated. Tie each heddle separately to insure uniformity of length. Place the finished heddles on two flat sticks and pull the sticks apart sufficiently to make all heddles equal in length. Apply a quick setting lacquer to the heddle eyes to secure the knots and stiffen the cord.

The reed should be easily detached from its support. The structural details shown in Sketches A and B, Fig. 5, are adequate. A detachable **roller type** warp beam and the hex rod which supports it are shown in Sketch C. The sectional beam described on page 270 and the guide plate which distributed the warp is shown in Sketch D, Fig. 5.



Portable Loom

Turn the Chained Warp on the Beam

The appearance of a warp removed from the warping board by the chain method is indicated in Fig. 6, Sketch 1. The "crossed threads" accumulated on pegs B and C are preserved between the knots tied in the cord which appears in Sketch 2. The other end of the warp is shown in Sketch 3. A stick, F-G, is passed through the loop made on peg E of the warping board. Also a cord is passed through the opening between the "bundles" of warp which were carried over and under peg D. Sketch 4 shows a "spreader" made by driving nails into a board. This is used to distribute the bundles of warp along the stick G-F. The stick G-F is tied to the warp beam, and after the warp bundles are distributed the beam is rotated and the warp is pulled over the spreader as it is wound on the warp beam see Sketch 5. Two lease "sticks" are inserted, one in each loop, B-C, and these are placed between the warp beam and the "harnesses." The next step in dressing the loom is to draw the warp through the heddles and then through the reed. The warp ends are then tied to the apron of the cloth beam. These steps are indicated in Sketch 5, Fig. 6.

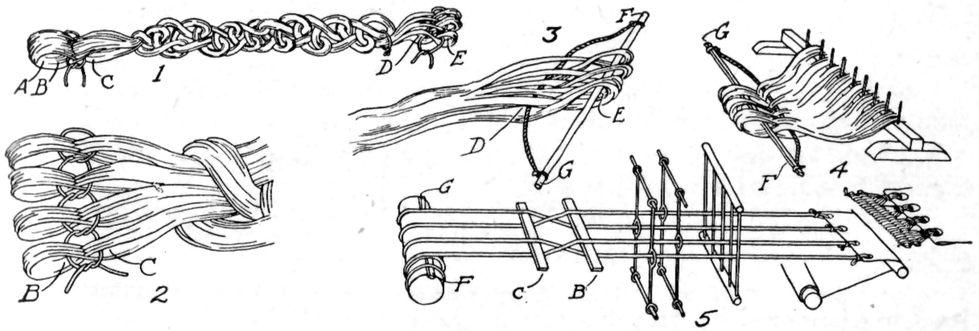


Fig. 6

Use of Paddle in Warp Making

A method of handling several threads at one time is indicated in Fig. 4, page 274, Sketches A to F. Make a thin board pierced with several pair of holes as indicated in Sketch A. Pass warp threads from a spool rack through the holes in the "paddle." Tie the ends together and loop them over peg A. Alternate threads are carried over and under pegs B and C. Sketches B, C, D and E indicate a manipulation which forms this cross in the warp threads. It will be noted the holes in the paddle present these threads in pairs, one forward and one back.

1. Place the forefinger on the lowest front warp thread and pull it down as indicated in Sketch B.

2. Move the hand forward to a position beyond the back lower warp thread, and with the thumb extended vertically.

3. Lift the hand slightly and hook the thumb behind the warp thread.

4. Pull the hand forward and again place the forefinger over the front warp thread in the next pair above. Again hook the thumb under the rear thread and pull it forward as indicated in Sketches C and D. Continue to separate the threads in this manner. Sketches E and F indicate how these cross threads are to be kept in this position by slipping them over the pegs B and C.

"American and European Hand Weaving," Helen Louise Allen, Brown's Book Store, Madison, Wisconsin.
"The Shuttle-Craft Book of American Handweaving," Mary Meigs Atwater Basin, Montana.
"Foot-Power Loom Weaving," Edward F. Worst, Bruce Publishing Co., Milwaukee, Wisconsin.

5. Carry the entire bundle of warp over peg No. 1 and forward around pegs 2 to 7. Refer to Fig. 3, page 271.

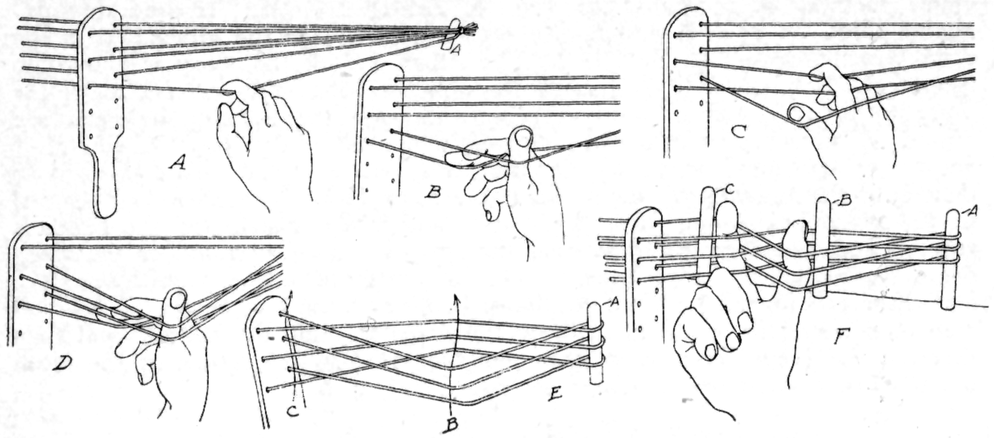


Fig. 4

6. Carry the entire bundle of warp over peg D, under and around pegs E, then under peg D and return to peg No. 1.

7. Repeat step 1 to 4, separating alternate threads and slipping the crossed threads over pegs C and B.

8. Carry the entire bundle of threads around peg A and again repeat steps 1 to 4 to form the crossed pairs.

9. Repeat steps 5 to 8 as many times as necessary to accumulate the total number of warp threads.

It is an aid in keeping count of the number of threads warped to tie a colored thread through the crossed bundle at pegs D-E and each time the bundle is carried around peg E and over or under peg D, pass the ends of the colored thread through the loop and tie a knot to separate the bundles. This will aid in counting the number of the bundles of warp. See Fig. 4, Sketch A. Also to preserve the crosses between pegs B and C a similar colored thread should be tied to keep separate threads in each group, together as a unit, see Fig. 4, Sketch B.

As soon as the required number of threads have been placed on the warp board, remove peg A and form a chain as indicated in Fig. 4, Sketch C.

Dressing the Loom, Using a Spooled Warp

The procedure outlined is for weaving plain cloth.

1. Place the required number of warp spools on the hexagonal rod, shown in Sketch 1, Fig. 5. The arrows showing the direction the warp is wound on each spool should point upward. Allow at least two extra warp threads at each edge selvage for reinforcement.

2. Break the gummed tape seal on the first spool and unwind one turn of the warp. Attach the band of warp ends to a small block of wood with gummed tape as indicated in Sketch 1. Unwind enough warp to reach over the harness as indicated in Sketch 2. About four turns should suffice.

3. Separate the warp threads from the strand one at a time, taking the right hand thread off the block held in the left hand as indicated in Sketch 2. Reach over the harness and hold the thread taut as indicated by Sketch 3.

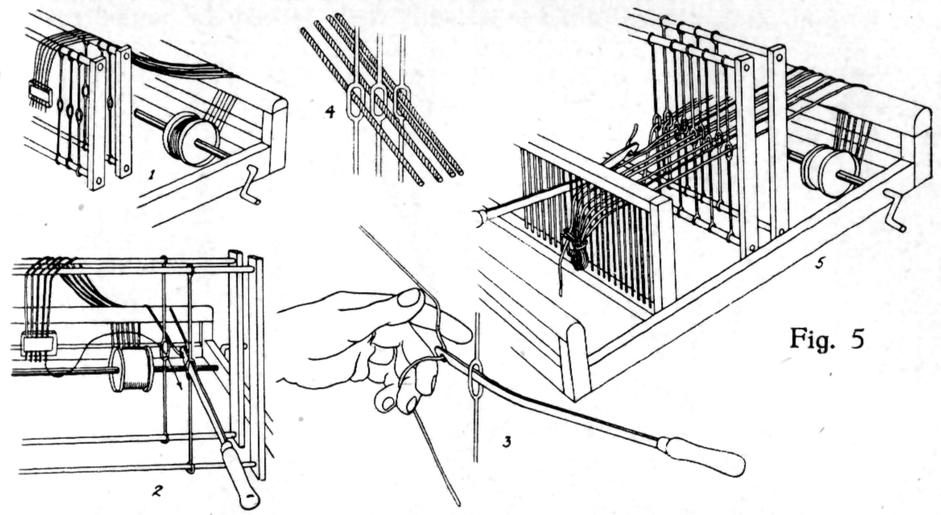


Fig. 5

4. Pass the hook, Sketch 3 above, also see Sketch SL-9, page 319, through the first heddle wire on harness H-1, Sketch SL-6, and draw it through the heddle as indicated by Sketches SL-9 and SL-10. Repeat this for each spool of warp thread. In case a double thread is used on the selvage two threads will be drawn through the outside heddle wires in each harness. See Sketch 4. This operation is called **threading the heddles.**

5. Place the reed in a vertical position and with the hook passed through each dent, Sketch 5 above, draw each warp thread in its turn through the proper dent. This process is called **sleying the reed.** After a group of 10 to 15 warp threads have been **sleyed,** tie a knot in the free ends of the entire group as indicated in Sketches 1 to 4, Fig. 6. This slip knot is readily untied and serves temporarily to keep the bundle of warp threads from accidentally passing back through the reed.

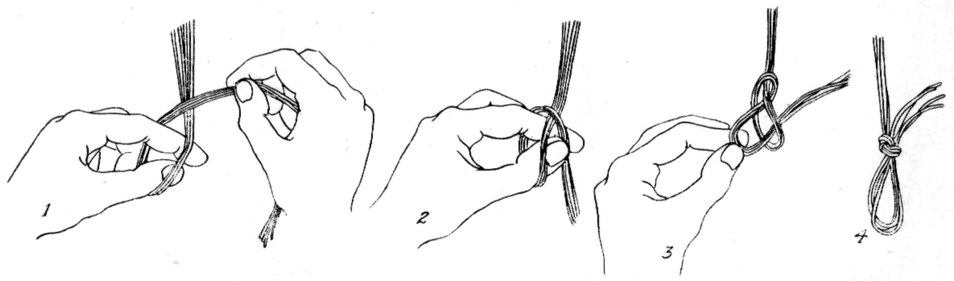


Fig. 6

Repeat the **sleying** process until all warp threads and both selvages are carried through the reed.

6. Attach the warp to the cloth beam. Several devices are used. Some times a piece of canvas known as an apron is attached to the warp beam with tacks and the free end is carried to and around the breast beam. In the edge of the canvas (see Sketch A, Fig. 7, page 276) a row of holes or metal eyelets is placed. Each bundle of warp is passed through a hole, and tied to the canvas. Sometimes dees are sewed to a canvas apron instead of using eyelets.

A more common practice is to attach a dowel rod to the warp beam with strong cord, see Sketch SL-1, and attach each bundle of warp to this rod, as shown below, Sketches 5 to 14.

Untie the knot in the center bundle of warp and divide it into two bundles approximately equal in size, and carry each half bundle of warp around the stick as indicated in Sketch 5. A special knot is used which keeps tension on the warp while it is being tied. It may be untied readily

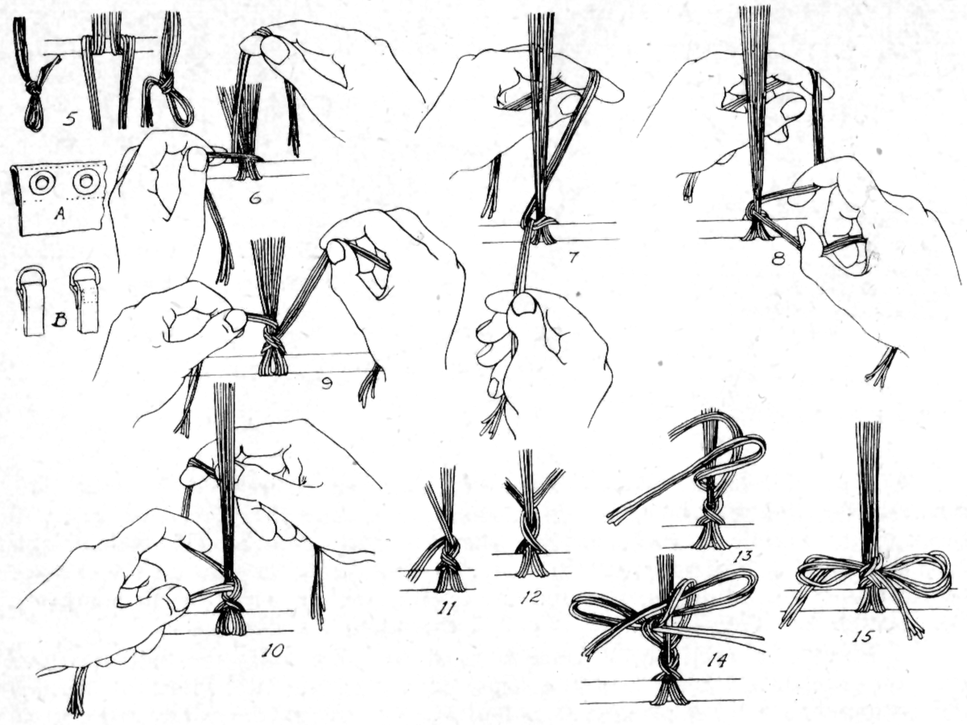


Fig. 7

and retied in case the tension in any bundle of warp requires adjustment. The method of holding the warp while tying this knot is developed in the Sketches 6 to 15.

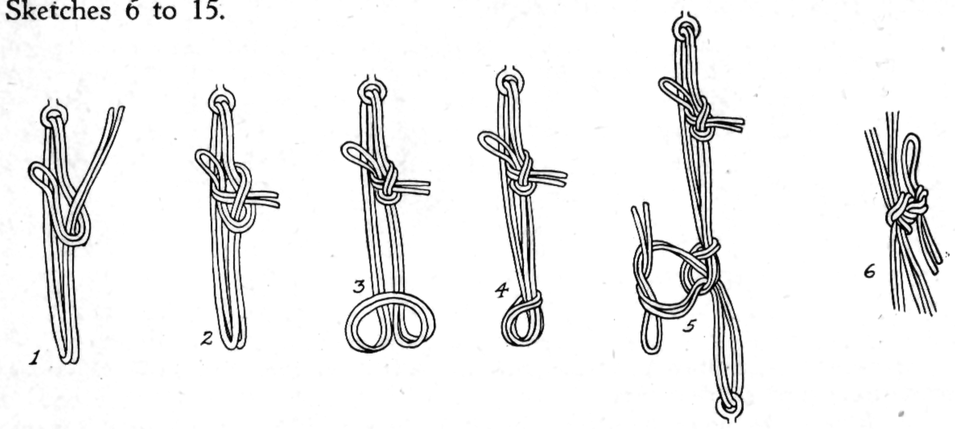


Fig. 8

7. Tie up the treadles as indicated in Sketch SL-5, page 251. The knot used is known as the snitch knot. It has the merit of being adjusted easily and holding fast after it is tied.

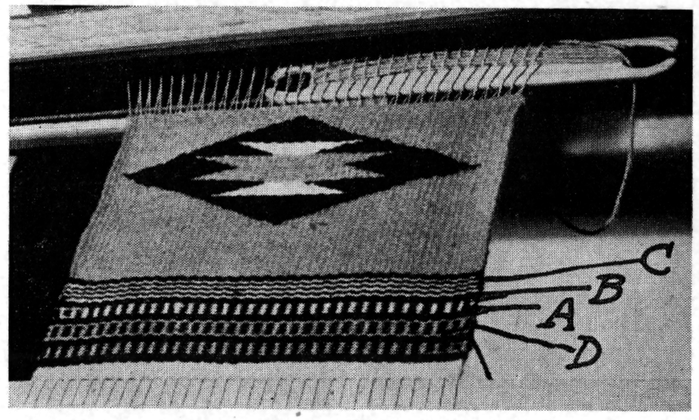
This hitch may be used with a harness as shown in Sketch SL-5. Here a rope is suspended below the harness and the treadle is attached to its center point. On harnesses where a screw eye is inserted in the frame the knot is tied as shown in Sketches 1 to 6, Fig. 8.

WEAVING

Simplified Portable Loom

Shuttle Stick Weaving—Spanish Technic

Weaving plain cloth on the simplified portable loom is accomplished by passing the shuttle stick containing the weft yarn through each shed. The accompanying photograph shows two types of striped patterns. Illustration A is a plain stripe in a solid color, produced by using one shuttle stick. B is a stripe produced by using two weft colors and two shuttle sticks. Pass each color through alternate sheds. C is another variation of this procedure, reversing the color arrangement. A twill or plaid effect may be produced by this method. D is a stripe also produced by using two shuttle sticks. Each weft color passes across the fabric through one shed and back through the opposite shed before the second color is used. This double passage of each shuttle stick yields a narrow stripe two weft strands wide.



Finger Weaving—Navaho Technic

The technic given on page 243 may be used to produce designs on this loom. The illustration shows a typical Navaho design produced by passing the balls of yarn weft through the shed by hand, see Sketch 19, page 243. The elements of design building are shown on page 243, Sketch 23-B. Methods of splicing weft yarn is shown by Sketch 23-A.

In case a warp thread should break, a method of making the repair is shown in Sketches 8, 9, and 10, Fig. 9. Tie a piece of warp thread to the end of the warp which passes through the heddles and reed. Wrap a few turns of this thread around a needle or a pin and draw the warp taut between the

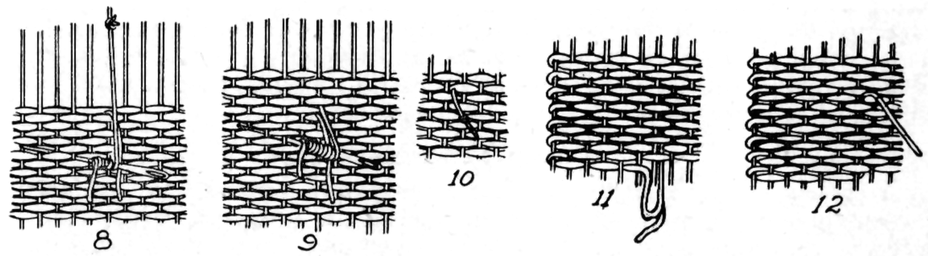


Fig. 9

two adjacent warp threads, fasten the needle to the fabric as shown in Sketch 8. Permit the loose end of warp to remain on top of fabric. Proceed with the weaving as indicated in Sketch 9. Later remove the pin or needle

Simplified Portable Loom

and tie the two ends of warp together, see Sketch 10. The ends may be trimmed off close up to the knot and the knot concealed by working it into the weft.

Loose ends of weft may be concealed as shown in Sketch 11 by carrying them under a few strands of weft with a needle paralleling a warp thread. Sketch 12 shows the end of yarn tucked under fine wefts. The protruding end will be trimmed off later.

Sketch 6, Fig. 10, shows the cord mechanism used to attach the warp to the cloth beam. Two holes are drilled near the ends of the rod to which the warp is tied and four holes are drilled in the cloth beam. Pass the attachment cord over the center of the rod. Carry each end over the breast beam and through the inside holes in the cloth beam, then along the cloth beam through the outside holes, again over the breast beam and through the holes in each end of the rod. Tie a knot in each end of the cord and adjust the cord through the holes until the rod is parallel to the cloth beam. Place tension on the warp by rotating the cloth beam which is secured by the ratchet and pawl shown in Sketch 6. The cord winds up on the cloth beam as indicated in Sketch 6.

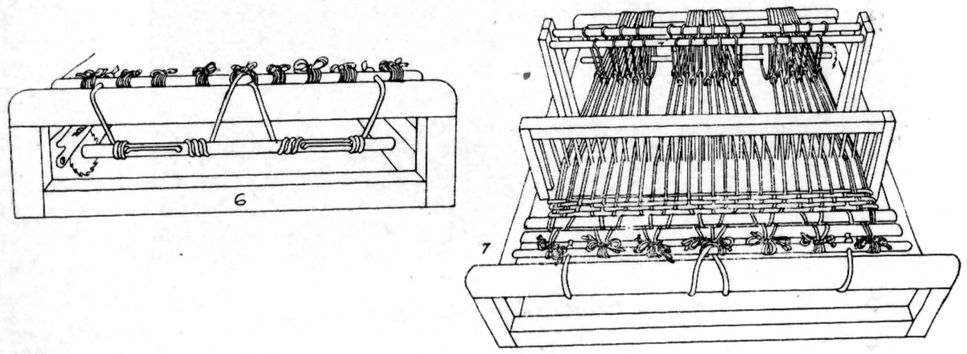
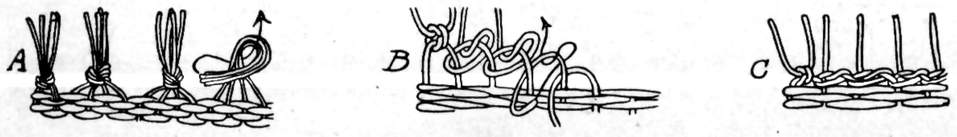


Fig. 10

Sketch 7 shows the appearance of the "dressed" loom. The warp has been carried over the spreader beam from the warp spools, through the heddle wires in the harnesses, and through the reed. Just back of the rod to which the warp is attached, two thin wooden slats are shown, one in each shed. Just back of these slats five strands of coarse yarn have been placed in alternate sheds. The purpose of these wooden slats and heavy yarn is to distribute the warp threads and make them equidistant, corresponding to the spacing controlled by the dents in the reed. Also the yarn serves as a pad, cushioning the blow of the reed. To remove the woven fabric from the loom cut the warp in front of the wooden slats. Remove the slats, heavy yarn, and tie an overhand knot in a strand or bundle of four warp threads. Slip the knot up against the weft before drawing it taut.

Warp Terminals

A typical warp terminal is made by tying an overhand knot in bunches of warp threads (3 to 5) as shown in Sketch A. A better terminal, which reinforces the edge, also made with an overhand knot, is shown loosely formed in Sketch B and drawn down against the fabric in Sketch C.



Block Printing

The demand for Holy Writ provided work for many scribes in Medieval times. Sheep, Goat and Calfskin, scraped thin and roughened (with pumice stone) to "take the ink," provided a durable record for hand written transcriptions. Charters of Medieval Rulers carried the approval of His Majesty the King, and authenticity of the document was recognized, when impressed with his official monogram. These monograms cut in blocks of wood or metal preceded the use of seals impressed in hot wax. Twelfth century manuscripts show initials which "on account of their uniformity," appear to be impressed with stamp and dies. Prior to the invention of printing, book binders used carved wood blocks to impress "names, legends, transcriptions" on their bindings. Two forms of carved letters were used: One a single "insulated" letter, engraved reversely, downward in a metal stamp whereby the letters appeared en relief on the leather or parchment of the binding"; another by "letters engraved reversely en relief on the brass stamp, whereby the letters sank into the binding." Hence the name impressor originally referred to the Binders of Books, afterwards it applied to the printer.

Impressions made by transferring ink from the surface of carved wood blocks to parchment served to illustrate hand lettered and illuminated manuscripts. All this writing, transcribing and illustration of parchment and vellum sheets, with pen and brush yielded to the art of printing from wooden blocks on silk, cloth, vellum and paper.

Skills of the wood carvers were readily adapted to the specialized demand for "block cutting." The block cutter had to see the design in reverse. As this principle was extended and the block cutting skills improved, refinements in tools, materials and methods, soon ushered in printing from movable type.

Blocks originally were cut in the surface of wood planks and the carver learned to respect the limitation and restriction to cutting imposed by the grain of the wood. Later these restrictions were removed as "block cutting" craftsmen became more skillful, finer detail could be executed and preserved in blocks sliced across the log. End grain blocks cut from Apple and Pear trees were in demand. The texture of these woods are especially adaptable to engraving, and they possess a toughness which insures long life in the print shop.

Molded material in sheet form, "type high," is now available for block cutting and engraving which is superior to the best wood. The modern material suited to the skill of the beginner as a "block cutter" and printer is the cork and burlap product Linoleum, Remnant pieces of the heavier grade, 3/16" to 1/4" thick are available in most communities at a nominal cost. Linoleum used for print blocks should be mounted on plywood. Mounted linoleum blocks are available in craft material supply houses in a range of sizes.

Linoleum Block Making

The tools shown in Fig. 1, page 280, Sketches C, D, E, are sometimes referred to as gouges. They correspond to wood carving tools, in fact the smaller size wood carving gouges and chisels are adaptable for linoleum block cutting. In Sketch C is shown a type of tool known as a veiner. D is a short radius gouge, and E is a medium or long radius gouge. Sketch F shows the style tool used by engravers and is known as a flat graver. It corresponds to the straight chisel found in wood carving tool kits. Another useful tool for block cutting is the incising knife, shown in Sketch F. The type of cut made by these tools is shown in Sketches C1-D1-E1, etc., correspond to the shape of the tools C-D-E. Sketch A shows a mounted linoleum block—a heavy piece of linoleum is cemented to a piece of plywood. Sketch B shows the form of a block, cut to print a letter and a border. The face of the letter

Set the Color

Artists color in oil are dependable for fabrics. Set the color printed on textiles with a hot iron. The iron must not be hot enough to scorch the fabric. Place the fabric printed side up on the paper towel and cover with a moist cloth. Again press with a hot iron. Reverse the fabric and press until the moisture is driven off. Repeat this process until the paper towel is free from stain.

Another technic in printing from an engraved surface is described on page 232.

Printing the Block

Some form of guide should be used to aid in alignment of the material to be printed. Cardboard or paper cut to size may be positioned with reference to the edge of the block. Fabrics should be stretched in a frame and

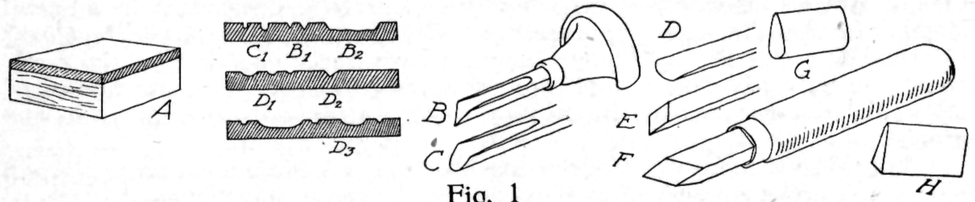


Fig. 1

centered. Place the surface to be printed upon the inked block and pass another clean rubber roller over the back of the material being printed. Lift the sheet from the linoleum and it should be imprinted with a clean cut design. Re-ink the surface with the brayer and repeat the process.

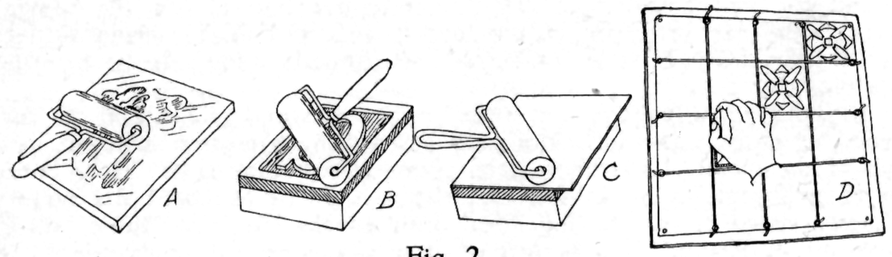


Fig. 2

Silk Screen Process

In the process of block printing described in the preceding page the ink is transferred from the surface of the block to the print. A print made by the silk screen process, is coated with ink which has passed through the screen. Construct a screen frame as indicated by Sketch A, Fig. 3. Stretch the fabric—silk or organdy, 8 to 20 mesh, preferably 12 mesh—over a wooden frame and secure with tacks. Hinge the frame—use a loose pin hinge—to a board on which the prints are to be made. This insures accurate register for printing. The loose pin hinge permits removal of the screen for cleaning.

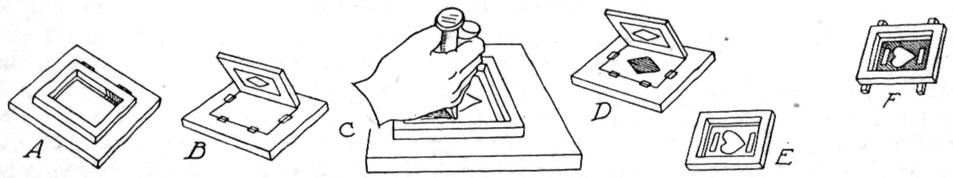


Fig. 3

The screen is an inking device. Ink is forced through the screen under slight pressure of the hand on a "squeegee." Any piece of stiff rubber similar to a "window washer's dryer" is adequate for the purpose. Ink may be forced through perforations in a stencil onto the fabric. Stencil prints are made by placing the stencil upon the fabric. The screen is placed over the stencil and ink is forced through the screen. The stencil prevents

any ink reaching the fabric except that which penetrates the screen and passes through the openings in the stencil. The ink applied to the first print holds the stencil in contact with the bottom of the screen.

The method follows. Place the design on the printing board under the screen. Outline the design in pencil, marking on the screen, which is translucent. Apply a glue size made of Le Pages glue and water, to the screen and permit it to dry. Apply a solution of shellac to all parts of the screen not enclosed by the design and permit this to dry. Wash the glue size from the screen with water and permit the screen to dry. Attach the screen to the printing board and apply ink with the squeegee. The ink is transmitted to the print through that part of the screen occupied by the design. The shellac coated surface effectively seals the screen and no ink is transmitted. Remove the shellac coating by washing the screen in denatured alcohol.

Other Types of Stencils

Trace an outline on an unsized screen with Asphaltum Varnish, using a fine brush, and permit the varnish to dry. Coat the screen with glue size. The screen should be supported on sticks during the application of glue. Permit the glue to dry. Dissolve the asphaltum varnish in turpentine and dry the screen with a cloth. This process may be facilitated by applying a coating of cornstarch paste to the under side of the screen before applying the asphaltum varnish. This size dries white and forms an excellent background for the asphaltum varnish.

Another method of printing fabric is indicated in Fig. 2, Sketch D. The fabric is stretched and thumb tacked over a pad, consisting of newspapers and four or five sheets of blotting paper. Guide lines are formed by stretching strings as shown. Carefully position the inked linoleum block over the fabric and within an area enclosed by the guide strings. Exert sufficient pressure on the block to slightly indent the blotter paper beneath the fabric. Re-ink the block and repeat in another area roped off by the cord guide lines. Use printers ink for printing on paper.

Multicolor Printing

The silk screen method of making prints in several colors becomes a precision process, when stencils are made on film paper. The film paper is made by coating a translucent base, with a thin film of plastic. Cut stencils with a "film stencil knife", making one stencil for each color. Strip the film coating from all areas to be printed in one color. Set the film paper in the printing guide, and place the screen on top. Apply solvent for the plastic film to the screen with a cloth, slightly moistened in the solvent. Slight pressure only on the cloth is required to coat the film with solvent and soften it sufficiently to make it adhere to the under side of the silk screen. Apply ink and print. Clean the screen by washing it in solvent. Proceed in the same manner to attach the film stencils to the screen for the succeeding colors.

Photographic Stencil Making

Another precision technic adaptable to silk screen printing is the photographic stencil. Apply a sensitizing solution to the screen. Place over sensitized screen—when dry—opaque paper silhouettes in the desired position. Expose the screen to light. The sensitized area under the paper cutouts is soluble in **hot water.** The exposed areas are hot water resistant. Dissolve the emulsion by washing the screen in hot water. Set the exposed background areas with cold water. Dry the screen and proceed to make prints. This technic is an effective one for making stencils in which fine detail, especially lettering, appears.

"Silk Screen Stencil Craft," J. I. Biegeleisen, Harper & Brothers, New York.

Batik

Batik is a form of handicraft used primarily in the decoration of fabrics. The correct word is **battik,** a Hindu-Javanese term which is applied to the textiles decorated in successive stages by the wax resist method on the Island of Java, where the art is developed to a high degree of perfection. Little is known of its origin but it likely was first practiced in Java by the Hindus who were among the first peoples to learn the art of textile decoration, centuries ago. When the East Indies were occupied by the Dutch in the 16th century the colonists were fascinated by the beautiful fabrics which the natives used for garments and for religious vestments and several books on the Batik Art of Java have been written by Dutch authors. Unfortunately none of these have been translated into English.

The Javanese Batik designs consist of a wide range of floral and geometric motifs, also intricate pictorial scenes from their religious shadow show ceremonies. Fantastic animal and bird forms are depicted, also allegorical figures, and several color combinations are employed, indicating many hours of patient effort in the repetition of the waxing and coloring process.

In parts of Europe Easter eggs are decorated by a batik or wax method with which is associated many curious customs. In Czecho-Slovakia elaborate designs and symbols are used in painting the eggs, and similar decorations are applied to turned woodenware articles of household use.

The Wax Batik method will be described, also simplified methods which will make it possible for the beginner, or an inexperienced group, to enjoy this fascinating craft with minimum equipment and with the assurance of successful results.

1—Batik, Javanese Wax Resist Method

Tools: Tjanting Tool, Prepared Batik Wax or 4 parts liquid wax and 5 parts paraffine blended together. Design and Coloring Brushes, Glass or Tin for melting wax, Small Deep Pan, Candy Thermometer, Graphite Paper, Drawing Board, Tracing Tool, Adjustable Frame, Dye Bath (Aniline-Alcohol Solution), Rubber Gloves, Paper Towels, Thumb Tacks, Gasoline, Pressing Iron.

Materials: Flat Crepe or Japanese Silk (unloaded or pure dye silk) are usually selected. China silk, also a smooth surfaced Georgette may be used if the material has not been sized, and soft cotton fabrics are satisfactory if first laundered to remove any starch. Light shades only are satisfactory, and very heavy materials are difficult to handle. A margin of one inch should be allowed for tacking or sewing the material to the frame.

Instruction:

1. **Transfer the design** from Blue Print or Sketch on tracing paper. (a) If a thin material is selected the design may be traced on the fabric from the tracing paper placed underneath. Both should be thumb tacked to a drawing board and a fine pencil used. It is desirable to use a colored Mongol pencil of a shade similar to that of the design outline. (b) On firm materials graphite paper is placed against the cloth with the tracing on top, and all are tacked to the drawing board. Be sure that the cloth is perfectly smooth and evenly placed in relation to the design before tracing the outline with a fine pencil or tip of the tracing tool.

2. Remove the fabric and tack it on the frame as indicated in Sketch B, Fig. 1. Equalize the tension. If a frame is not available, one edge of the fabric may be tacked to the board and the other held taut as the color is applied.

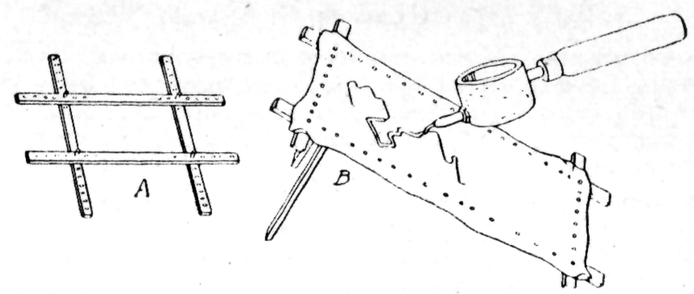


Fig. 1

3. **Preparation of the wax.** This step is most important as success depends on the correct mixture and temperature of the wax. Prepared wax may be placed in a glass or tin container which is then heated in a pan of water. Use cold water which should fill the pan to the level of the wax, and heat slowly. An electric plate is desirable, but a gas or Bunsen burner may be used if care is taken not to permit any of the wax to come in contact with the flame. Heat to a temperature of about 160° or until the wax is entirely liquified.

If a mixture of wax and parafine is to be prepared melt both separately before mixing so that exact proportions may be determined. When the wax preparation is liquefied allow **to cool to 140°**, and fill the reservoir of the tjanting tool which should be heated in the water and dried. Test the tool on a scrap of the material and if the wax does not run readily clear the spout with a fine wire or a bristle. The wax should penetrate the fabric and form a line on both sides of the cloth of about 1/16" as the tip of the tool follows the design outline. Hold in the position shown in Sketch B and proceed as rapidly as possible. If necessary to lift the tip from the fabric for an instant, hold a piece of blotting paper under the tip so a drop of wax may not fall in the wrong place. A continuous line of wax must be left on the fabric, otherwise the dye will run into the design area. If a wider line is desired heat the wax until it spreads slightly. At 160° the line will be about 3/32". Large areas also may be more readily covered if the temperature of the wax is higher. Brushes may be used instead of the tool for applying the wax to areas which are not to be dyed. Wax all parts that are to remain the original color and all that will be dyed contrasting colors.

4. **Dyeing.** Dampen the material with luke warm water (cold water may crack the wax and hot water will melt it) and dip it in a cool dye bath of the lightest color of the design. When the color is uniform remove the cloth from the dye and rinse well in cool water until the dye ceases to run. Pin it on the stretcher and pat gently with paper towels to hasten drying. When the fabric is thoroughly dry cover all parts which are to remain the first color with an application of wax. Again dampen the fabric in luke warm water and immerse in the second dye bath. Remove, rinse and dry as before on the stretcher. Several successive dips in different dye baths may be made, but it is best to restrict the coloring to three or four harmonious shades.

Removal of Wax. Two methods of removing wax are possible:

1. Place the fabric between blotting paper and press with a moderately hot iron until the wax disappears. Move the paper frequently to permit absorption of the wax. Any remaining traces of wax should be removed by dipping in gasoline.

2. Immerse the fabric directly in gasoline and stir until the wax is dissolved. It may be necessary to change the gasoline several times if a quantity of wax has been used.

2—Batik, Dye Stopper or Gum Arabic Method

The same principle as that employed in the wax method is used, in that the outlines or other parts of the design are protected by a dye resisting agent when the color is applied. This is a simplified process which will enable the beginner with limited equipment and experience to secure color effects as beautiful as the wax batik.

Tools: Gum Arabic solution (2 ounces dissolved in about 6 ounces of cold water), Flat Liner or Pointed Brushes for outlines, and Round Water Color Brushes for backgrounds, one of each for as many colors as are used. Two Medicine Droppers, Drawing Board, Paper Towels, Adjustable Frame, Thumb Tacks, Small piece of Glass.

Materials: Silk or Cotton Fabrics, same as for Wax Batik. Pieces must be cut one inch larger than the design to allow margin for attachment to the frame.

Instruction:

1. Transfer the design to the cloth, using graphite paper between the tracing and the material, or trace directly from blue print or sketch.

2. Stretch the fabric in the frame so that tension is equal on all margins, or thumb tack it to the edge of the drawing board, as suggested under wax batik, page 283.

3. **Application of Dye Resist.** If the outline is to remain the color of the original fabric apply the clear gum Arabic solution with a fine pointed brush to the design tracing. Experiment on a piece of the fabric before touching the design to test the consistency of the solution and the method of controlling the width of line by varying the pressure of the brush and the rapidity of motion. The solution should seem like a syrup and flow from the tip of the brush in a line about 1/16″ to 3/32″ in width. If it does not penetrate the fabric it is too thick and may be thinned with a little water. If too thin it will run and spoil the outline margins in the coloring process. The solution will thicken by evaporation if left exposed a few minutes in an open dish.

Areas which are to resist color should also be evenly stopped out with the gum Arabic syrup and the material left to dry thoroughly before coloring.

4. **Color Outlining** of the design may be readily done with a gum Arabic solution to which a little of the concentrated dye has been added. Mix only a small quantity as needed and combine exactly as directed. **First** put about a teaspoon of the **gum Arabic solution** in a small container and **second,** add very slowly with a medicine dropper a few drops of the dye, stirring gently until the shade is uniform. If the process is reversed or excess dye is added at a time the mixture will coagulate. A small quantity of the solution may be prepared on a piece of glass. Drop on the glass a very little of the gum Arabic syrup which will retain a globular shape, add with the dropper, or with a fine brush, a drop of dye and mix carefully with the outline brush before applying. If it dries a drop of water will restore it to the right consistency. Outline the design as indicated in Step 3, also apply the colored solution to any areas which are to resist further coloring.

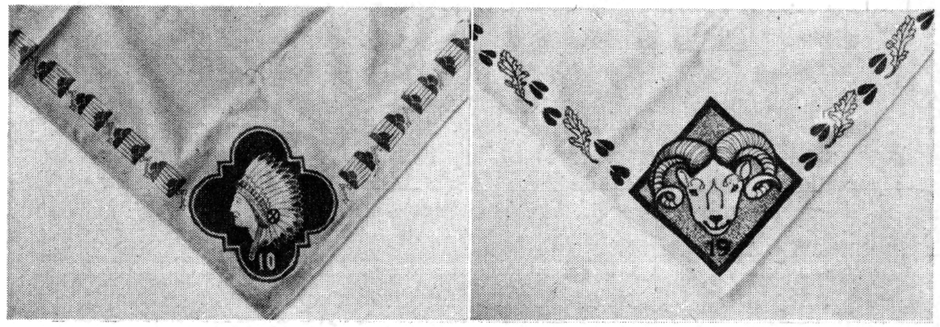
5. **Design Coloring.** After the gum Arabic has thoroughly dried, carefully flow the dyes, which have been diluted or mixed to the desire shades over the design areas and along the outlines. Start about ¼″ from the outline. as the color will flow toward the line and any excess may run across it to the next area. Direct the brush strokes with the thread of the material, except near the outline where the stroke must parallel the line. A water color brush may be used for large areas and a liner brush for flowing the dye up to the outlines. Shaded effects may be secured with one dye by

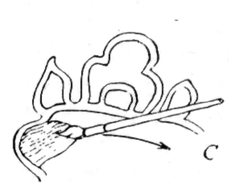
brushing the surfaces which are to appear lighter with clear alcohol before applying the colors.

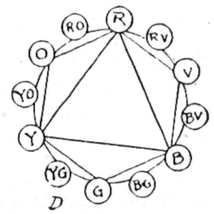
6. **Removing the Gum Arabic.** Immerse the fabric in **cold water** or hold under the faucet, and strip it with the fingers until all the gum has been dissolved. Place between paper towels and pat gently to remove as much of the moisture as possible, and when nearly dry press between a fold of dry paper towel or cloth, with a moderately hot iron.

7. If a crackle effect is desired, coat the entire surface of the fabric with the clear gum Arabic solution, after the colors have all been applied and the material entirely dry. When this coat is dry and stiff crush in the hands until the desired crackle lines have been broken through the gum and then paint on a light wash of the color desired for the crackle. This should be a shade darker than the design colors, and if carefully rubbed into the crackle lines will result in a delicate webbed effect which is characteristic of true batik. When this color is dry, wash as directed in Section 6.

8. Fabrics decorated with Batik coloring may be adapted to many purposes. Scarfs, Handkerchief, Pillow Tops, Table Runners, Spanish Shawls, Wall Panels and other items for personal and household use may be designed to harmonize with garments or furnishings. Sketch D is a related color chart which may be used as a guide in selecting colors that are harmonious yet will permit sufficient contrast for textile decoration. Sketch E shows the proportions in which the primary colors are mixed to secure secondary and related shades. Good color schemes can be secured by using together any of the colors found in the same segment of the circle. Nature constantly offers perfect examples of color harmonies and contrasts. Other sources for suggestive color schemes are rug and textile designs, such as are frequently shown in advertisements. Oriental rugs and fine old furniture, also the paintings of old masters, are sources of inspiration in a study of color harmony and design.







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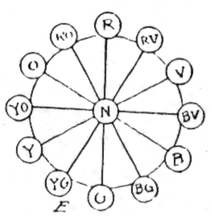


E

The Scout Neckerchiefs illustrated above are decorated by the Batik method described on pages 282 to 285.

Mineral crystals having large natural facets were among the earliest jewels worn for personal adornment. Their scarcity and the fascination for these natural light reflecting surfaces, long ago prompted primitive man to give thought to the ways and means by which these cherished objects of charm and beauty could be made. The skill and ingenuity of early craftsmen was challenged and the methods of polishing stone surfaces gradually developed.

An advance in the art occurred when the process of drilling holes in gems and precious stones was discovered. Pearls became of great value. When pierced with a hole, these lustrous concretions could be worn as jewelry and immediately became an art object greatly sought for personal adornment.

The object of polishing semi-opaque and opaque stones is to enhance the natural beauty of the specimen by adding surface luster to color. Color is the chief criterion in judging quality of gems desired for personal ornament, excepting the diamond where brilliancy is the first consideration. Cutting for brilliancy or the art of faceting may be dated to the 15th century when diamonds were added to the jewel box of royalty and worn as personal ornaments. The acquisition of this skill followed the contribution of scientific research and discovery. The law relating to the incidence of light—both the refraction and reflection of light by surfaces or faces (facets) and the refractive index of the gem had to be known before cutting specifications could be computed. This was a job for the physicist.

The cutting of fifty-eight facets required on a full cut brilliant diamond with diamond dust in oil, was a job for the professional lapidist.

Several styles of stone cutting have been developed for the translucent gems; rubies, emeralds, sapphires, garnets and others, as well as the diamond, which employ the use of facets for adding brilliance to color.

Opaque or semi-opaque stones are polished to add lustre to color. This style of cut is known as the Cabachon and consists of rounding off corners and edges by grinding on abrasive surfaces.

Shaping by Abrasion

The bead making of the primitive Red Indian was confined largely to bone, horn, and the softer stones—Talc, Gypsum, Alabaster, Jet, Malachite and others not exceeding the hardness of Turquoise.

Other stones ranging in hardness from the turquoise to agates and petrified wood challenge the skill of craftsmen to cut, shape and polish sets for jewelry or specimen collection. Due to the greater hardness of these stones, modern methods and abrasives are required to produce the desired size, shape and surface finish.

Enjoyment comes to the craftsman who liberates the beauty inherent in a dull uninteresting pebble or stone by cutting and polishing a single face. This quest opens up a wide horizon of interest and beauty hitherto enjoyed only by the professional lapidist and vender of precious and semi-precious stones.

Surfacing a Specimen—Hand Method

The specimen to be polished should have one face approximately flat —either a natural face produced by breaking with a hammer or made by a cross cut with a suitable saw.

A smooth surface (piece of glass or metal) may be used to polish the flat face of a specimen by the following procedure:

1. Place a few drops of liquid (water, light oil, turpentine) on a piece of glass and sprinkle into the pool of liquid some No. 100 grit carborundum powder.

2. Place the flat surface of the specimen in the liquid and rotate it with the fingers as indicated by the arrow. Continue to rotate the specimen until it has a uniform surface appearance of sanded or frosted glass.

3. Remove the liquid and abrasive with a cloth and clean the plate. Be sure all trace of the abrasive is removed.

4. Add more liquid and sprinkle into the pool some No. 220 carborundum powder and repeat the process described in 2. This procedure may be repeated, using a finer grit abrasive which may be had in No. 300 to No. 500.

5. Finish with Tripoli (a fine abrasive in wax) on glass or with Tin Oxide on a piece of leather.

Sawing Stone

Stone having a hardness not to exceed that of Gypsum, Alabaster and Jet may be cut by a saw blade having teeth on the cutting edge. Hand saws for wood and hack saws for metal are suitable for this purpose.

Turquoise, Agate, Petrified Wood may be cut by a disc of thin metal (without teeth in its edge) which passes through a semi-liquid solution of water, oil and abrasive powder. Carborundum is the cutting substances used commercially and is available in grades ranging from coarse and medium grits for cutting to fine for surfacing and polishing.

The abrasive powder mixed with water and the addition of stone dust forms a mud like mixture, from which such a saw derives the name of **mud saw.** Similarly a smooth edge metal disc running in a mixture of oil and abrasive powder is known as an **oil saw.** In either case the cutting action comes from the grit coating on the edge and sides of the metal disc which rotates against the stone. Only a slight pressure is required. Another type of saw may be made by charging a metal disc with the dust of black diamond. This disc is run in a lubricant.

Much may be done with inexpensive equipment (see page 288) made by the individual craftsmen of average ability and skill. The processes presented are listed in the order of their use.

Stone Sawing, Grinding and Polishing Equipment
Mud Saw Construction

Mount an 8″ to 10″ disc of 20 or 22 gauge sheet metal (brass, iron [black or galvanized or tinned]) on a shaft or arbor. See Sketch 1, page 288.

Use a 1/4 H. P. motor belted to the drive shaft. Pulley sizes should permit shaft speeds from 200 to 900 R. P. M.

Partially cover the disc with a metal housing as indicated by Sketch 2.

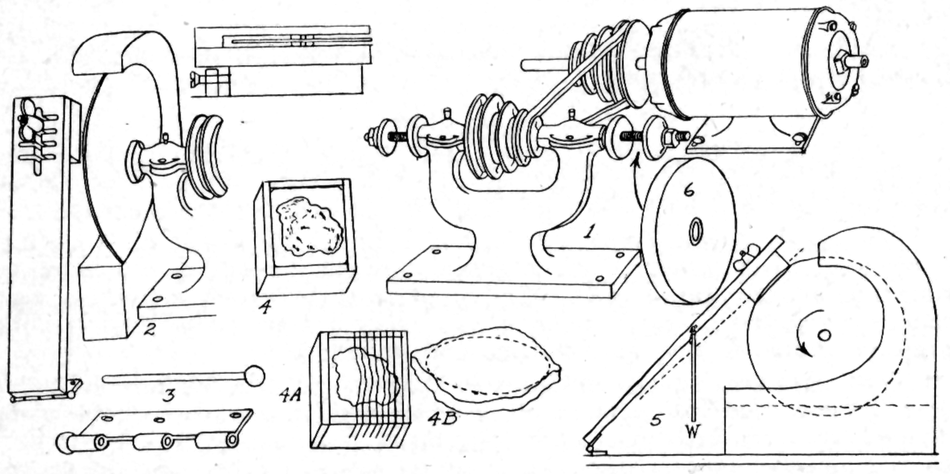
Run the disc in a liquid (water and abrasive powder) to which clay powder (or a soap powder) may be added for thickening. Gold Dust soap powder makes a good liquid base which holds the abrasive powder in suspension without forming suds or lather. This liquid mixture coats the sides and edge of the disc and is carried to the point of contact with the stone as indicated in Sketch 5. The excess liquid flung off the metal disc strikes the splash guard and is returned to the reservoir.

Mount the specimen to be sliced in a small box, setting it in plaster of Paris or Dental wax as indicated by Sketch 4. See page 301 for method of handling plaster of Paris.

Attach the box containing the specimen set in plaster or cement to the end of the board shown in Sketch 5. The board may be made detachable by using a loose pin hinge indicated in Sketch 3. Adjust the specimen and saw blade at point of control to permit the blade passing through the specimen without readjustment.

Slicing or Leveling a Specimen—With Mud Saw

1. Fill the reservoir with a mixture consisting of No. 100 carborundum powder, water and Gold Dust—an equal measure of grit and soap powder to five or six of water. Add water as the mixture thickens due to evaporation and the accumulation of stone cuttings.



2. Place the specimen, encased in plaster of Paris or Dental Wax in contact with the revolving disc. The rotation of the disc should be counter clockwise, see Sketch 5.

An average cutting rate for this type of saw, abrasive mixture and a speed of 200 to 300 R. P. M. is about 2½ inches per hour.

3. Saw cut the sliced specimen into dimensions corresponding to the length and width of the desired finished shape, either by hand or remounting in plaster of Paris or Dental Wax.

Grinding and Polishing Equipment

Equip the end of a motor driven shaft to receive carborundum grinding wheels of different grits, also wooden discs and felt wheels. The speed required is about 800 to 900 R. P. M. Provide a metal splash guard to surround the wheel as indicated in Sketch 6.

Two carborundum wheels—one No. 150 grit, the other No. 180 grit, are desirable equipment. Abrasive in powdered form should be available. Carborundum powder grits, No. 150 and No. F, pumice stone, tin oxide, wooden sticks and wax for mounting stones for grinding are necessary.

Shaping Stones

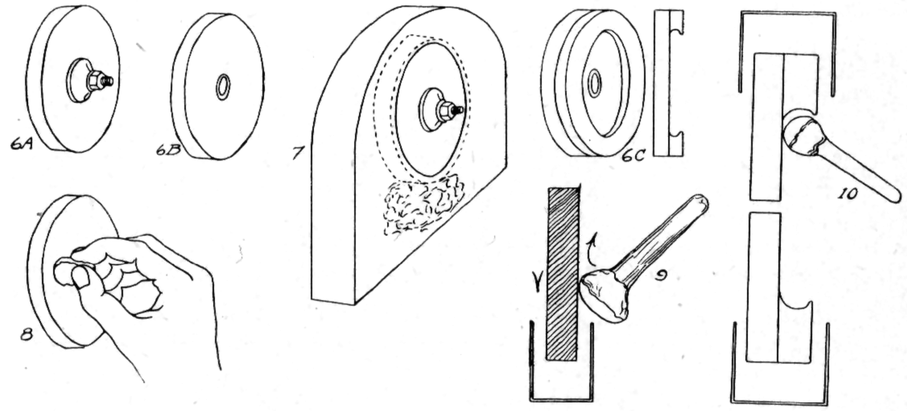
Stones previously sliced may be mounted on sticks with wax since they have a flat base produced by the saw. Stones not saw cut are leveled or ground flat on the base on a carborundum wheel No. 100. Hold the portion to be leveled against the wheel with the fingers. The operation of rough grinding follows:

Fill the reservoir of the splash guard with water to a depth almost touching the carborundum wheel. Wedge a sponge between the wheel and bottom of reservoir, to keep the wheel wet. The grinding of the base of the specimen is done on the side of the abrasive wheel as indicated in Sketch 8. This rough grinding or leveling operation is sufficient for an opaque stone which is to be mounted on a solid base plate. A translucent stone, however, requires the base to be polished as well as the outer surfaces. This is done in the manner outlined.

1. Attach a wooden disc to the shaft. Cover with a splash guard and coat the surface with a paste of water and No. 150 carborundum powder. Apply the paste with a paint brush.

Hold the flat surface of the stone against the revolving disc until the surface takes on a uniform frosted appearance.

2. Change to another wooden disc and repeat Step 1, using a paste made of No. F carborundum and water. Repeat with pumice stone and with tin oxide.



Attach Stone to Wooden Stick for Grinding to Shape

The process of attaching stones to wooden sticks with wax is known to stone cutters as "sticking the stones." This procedure is illustrated and described on page 198 for turquoise.

An improvement over the sealing wax mentioned is the mixture of one half sealing wax and one half stick shellac. This mixture is less brittle and withstands higher temperatures developed while grinding without softening and loosening the stone. Dental Wax is excellent for this purpose also.

A good practice is to warm the stones as well as the wax and shape the wax around the stone with wet fingers. Trim excess wax off with a knife. Do not cool stone by dipping in cold water unless it is ready to be removed from the stick. Before changing to a wheel of finer grit or to a wooden disc and paste, wash the specimen and stick in water with a brush.

Press the mounted stone against the rotating wheel No. 100 or disc as indicated in Sketch 9. Note the movement of the stone against the wheel is in a direction away from the base of the stone. This avoids flaking or chipping the stone.

Repeat this procedure, using wheel No. 180.

STONE WORKING PROCEDURE

Polishing Rough Ground Shapes

Paste Cuts

This operation is sometimes done on a wooden disc or a felt covered wheel. But this process is slow when a flat surface wheel is used. It may be speeded up by using a wooden disc shown in Sketch 10, known as an internal grinding wheel, which consists of a plain wheel to which a wooden ring containing a concave circular groove has been added.

This groove serves to hold the abrasive paste in contact with the curved surface of the stone being polished while a flat surfaced wheel charged with abrasive paste makes only a point or line contact with the stone.

Repeat this operation, using a separate wooden wheel for each size grit. Use No. 150 carborundum powder first, then follow with No. F powder.

Pumice Powder Cut

Replace the wooden grinding wheel with a felt wheel, using one-inch thickness if unsupported by a wooden disc. Charge with medium pumice powder paste and continue to polish until the entire surface shows a uniform appearance.

Finishing Cut

Replace the felt wheel with another charged with tin oxide or rouge for the final or finishing cut.

Precaution

The utmost care should be exercised at all times to avoid mixing abrasive powders. It is a good practice to have a separate container for both the grit and the wooden wheel on which each powder is used. The slightest amount of coarse abrasive mixed with a finer abrasive powder will produce scratches on polished surfaces.

Care of Metal Saws

The thin metal discs sometimes wear eccentric in shape due to variation in the hardness of specimens. This getting "out of round" may be corrected with a file. A better method is to place the metal disc in a clamp which permits it to revolve freely in a horizontal position while it is fed against a carborundum wheel. Such a device is shown on page 288 above Sketch 2.

Shaping by Flaking

This method applies to stones having special characteristics. Not every stone may be made into an arrowhead. Only those stones which break under pressure into spawls and flakes having thin edges may be shaped into the cutting tools used by primitive man. The primitive methods of working stones are indicated elsewhere in this manual. For the technic used in the flaking of **arrowheads,** see page 445—cutting, polishing, drilling turquoise, see pages 198-199-449.

This manner of breaking, or fracture as it is called by geologists, identifies stones which may be shaped by the flaking method. All flaking stones have this "conchoidal fracture." This name is derived from the shape which resembles a mathematical curve known as a *conchoid. The shell shaped cavity having a smooth glass like surface which appears to be scraped out is the characteristic shape of the break.

Obsidian (volcanic glass), Flint, Jasper, and others, also ordinary window and bottle glass, all break in this way.

*This curve is developed by a point on a circle or a mark on a wheel as it rolls along a plane surface. The path described by this mark begins when the mark is on the ground and as the wheel is rolled along until the mark is again on the ground.

STONE WORKING PROCEDURE

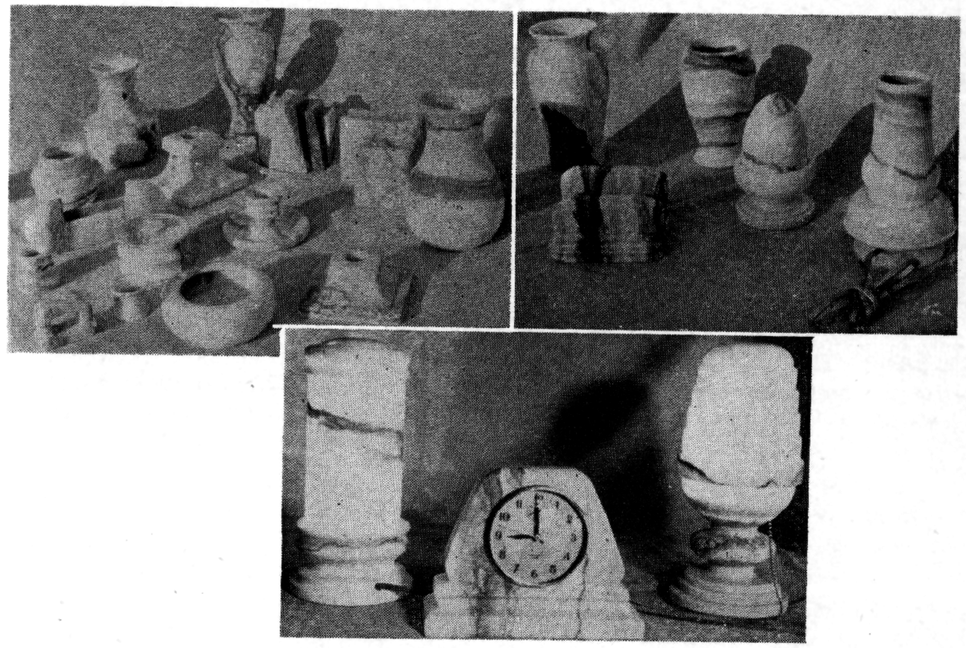
Alabaster

Colorado Alabaster is a natural stone ranging in hardness from that of Gypsum (Calcium Sulphate) to that of Marble (Calcium Carborate) depending on the specimen selected. Chemically this stone from Colorado quarries is a mixture of calcium sulphate, varying in amount from 50 to 70 per cent, and calcium carbonate (30 to 50 per cent). The hardness in each piece varies considerably as may be detected with hand tools, also by the difference in color.

The color marking ranges from white, pearl grey, pale green, delicate pink, red brown to dark brown. Onyx like markings of irregular veining separate these colored areas, which may be embodied in matched designs through careful selection of rough pieces for cutting and sculpture. These variegated colors and irregular vein markings which have the texture of lustrous satin are a source of beauty to be found in all polished surfaces.

Alabaster makes excellent material for beginners as it is not necessary to resort to elaborate sculptured shapes to liberate its inherent charm. The artist craftsman, by securing translucent effects, adds greatly to the beauty of the natural markings in the alabaster, thus enhancing its value.

Since this stone may be worked so readily by hand, also cut, shaped, and polished by power tools, procedures for both methods are detailed and several suitable projects for each method are suggested.



Working Alabaster—Hand Method

Woodworking tools are satisfactory for cutting alabaster. Cutting edges become dull, yet serious damage to the tools rarely occurs, because the care which must be exercised to prevent fracture of this stone is a safeguard to both the tools and the finished article.

Cutting Alabaster

1. Place a piece of alabaster (rough stone) on a workbench and wedge securely between blocks of wood.

2. Saw to the approximate size and shape with a coarse toothed saw. Rip saws for wood, pieces of band saw blades or coarse toothed hack saws

*The photographs show work done by Mr. Chas. E. Roberts in his shop on Highway No. 287 at the Owl Canyon Alabaster Quarries, near La Porte, Colorado.

are suitable for this roughing out process.

3. Smooth and true up edges with a medium cut wood rasp. This is a safeguard against edge chipping as the shaping progresses.

4. Cut to the desired shape with edge tools. A pocket knife scraper made from old files, coarse and medium cut wood rasps, chisels, gouges, hand drill, wood and metal bits. Coping saw, No. 2½ sand paper may be used.

5. Surface the carved alabaster with No. 0 sandpaper.

6. Smooth all surfaces with No. 000 steel wool dipped in water, or follow a wet sponge with wet or dry abrasive paper No. 000. Wipe the alabaster dry and inspect for a smooth scratchless finish.

7. Allow the alabaster to dry (overnight in a warm place) and oil all surfaces with linseed oil. After ten or fifteen minutes wipe with a dry cloth removing all oil.

8. Polish with a soft dry cloth or piece of leather sprinkled with a little pumice stone powder, for a mat finish—or charged with a fine grade of jeweler's polishing rouge for a high gloss finish.

9. Mounting of finished Alabaster upon a felt base is desirable to prevent marring polished glass or finished wood surfaces. This felt may be attached with a good grade of glue. Hoof or casein cold water glue is preferable to a celluloid acetone base cement.

Working Alabaster

Machine Method

Alabaster can be turned on wood or metal working lathes. It may be chucked or attached to a face plate with wood screws. Either wood or metal lathe tools may be used, also coarse rasps and files.

1. Chuck the rough piece of alabaster as is customary for handling wood or metal. True up one end and turn as large a cylinder as may be made from the rough section, and shoulder the cylinder to fit the chuck diameter. Reverse the piece in the lathe and continue cutting. Work at slow speed, 300 to 400 R. P. M. until the piece is running true between centers.

2. Wet the turned piece of alabaster with water (applied with a sponge) and press No. 0 sandpaper against the moist surface to remove tool works and bruises.

3. Polish with fine pumice stone or abrasive powder applied on moist cloth. Follow with a jeweler's rouge (tripoli compound or crocus powder) applied on cloth. Burnish with a strip of moist canvas held against the polished surface.

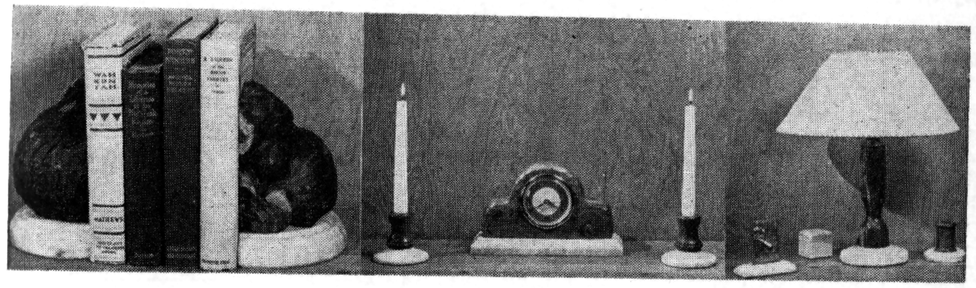
4. Water proof vases or bowls by heating them to a temperature of 110° to 120° F. in an oven. Pour melted paraffin inside and rotate until the surface is coated. Remove excess after a uniform layer has been deposited.

Step 3 may be more rapidly accomplished on cloth buffing wheels—use 6″ to 8″ diameter muslin wheels and about 400 to 500 R. P. M.

Care should be exercised to protect the lathe base plate and other parts from the coating of dust. Covering these parts with a damp cloth or newspaper is sufficient for turning an occasional piece of alabaster. The installation of air exhaust blowers, with the exhaust enclosed in a bin or carried outside the shop, should be made where much lathe work is done.

Projects—Alabaster, Cedar

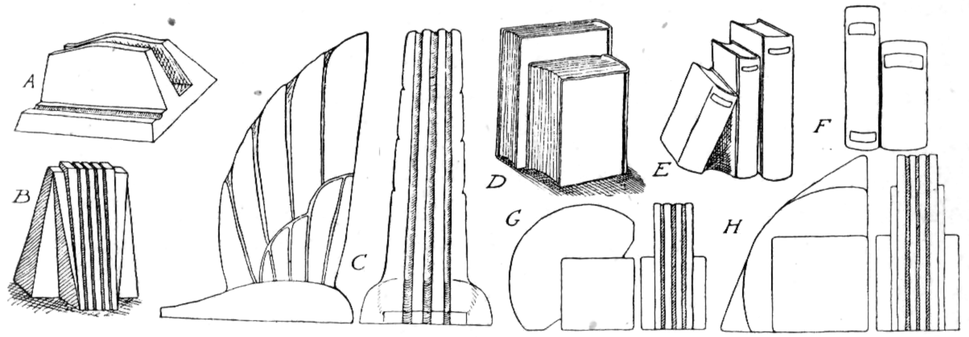
Another material, also a native Colorado product—the Rocky Mountain Red Cedar—combines exquisitely with Alabaster. The red and brown markings of both the Cedar and Alabaster form a harmonious combination and supplement each other in pleasing contrast. Alabaster being stone finds a natural use in foundation structures. It is heavy and suitable as a base to support a super structure of wood. In such projects as Book Ends, weight is desirable. The pair of book ends shown in illustration A are made from a Cedar Burl, mounted on an Alabaster base.



A B C

The burl was divided in two sections of approximately equivalent masses by a saw cut. The faces of each mass were smoothed and another saw cut made at right angles to the face. The Alabaster base was turned on a lathe, cut in two and attached to the cedar pieces with wood screws. A piece of leather was cemented to the bottom for protection of the surface otherwise in contact with the alabaster.

Other projects suggesting Cedar-Alabaster combination are shown in illustrations B and C. Candle sticks—base and frame for an Electric Clock movement—Lamp Base—Photo Holder—Paper Weights and many others are possibilities.



In Sketches A to H are shown several designs suitable for book ends. Here weight is desirable and the designs suggested are purposely massive to supply the desired weight. Other suggestions suitable for Alabaster carving, are shown on page 318 where they are listed under suitable projects for modeling in clay. They may be carved or sculptured by hand or with motor driven tools.

Interest in working with clay might be dated if the records of old sun-dried clay vessels were not long since reduced to fine dust.

Remnants of fire baked clay ware are found widely distributed and trace the efforts of primitive man in pre-historic times to devise domestic utensils. Earthenware is mentioned in Mosaic writings and the Egyptians are thought to have discovered the art of glazing, which was perfected in Greece and Italy and introduced by the Arabs into modern Europe about the 9th century of our era. Surpassing achievements in the modeling and decoration of pottery were found in the new world by the invading Spaniards in the 14th century but it has not yet been determined when the art was discovered or introduced to the natives of our Southwest as well as those of Central and South America.

The projects selected and the several procedures used in clay working, given mainly in the order of development, are presented for the craftsman at home, in camp or school. The construction of essential equipment is recommended as a desirable phase of the craft.

Clay is mineralized earth or disintegrated rock. Clay pockets occur where an accumulation of insoluble precipitates is left from receding or evaporated water. Strata of clay are found in dry lake beds and in formations of sedimentary rock. To be suitable for pottery making, clay must have specific chemical properties which when present cause it to fuse or vitrify during the firing process. Occasionally these are found in the right proportions, but natural clay mixtures which will fuse and glaze successfully are extremely rare. Unless facilities for testing and the development of specifications are available it is recommended that commercially prepared clays be obtained and mixed according to standard formulae. Ceramic supply dealers are listed on page 318. Commercially prepared clays are tempered and fitted to the glazes so that the expansion of a clay mixture, when it is fired to the fusion point or "bisque fired," and its shrinkage during the subsequent cooling, will not crack the piece. Glazes also must be adjusted chemically to the clay to withstand its expansion when fired to the melting point of the glaze, "glost fired," and the shrinkage on cooling.

Preparation of Pottery Clay for Ship Casting

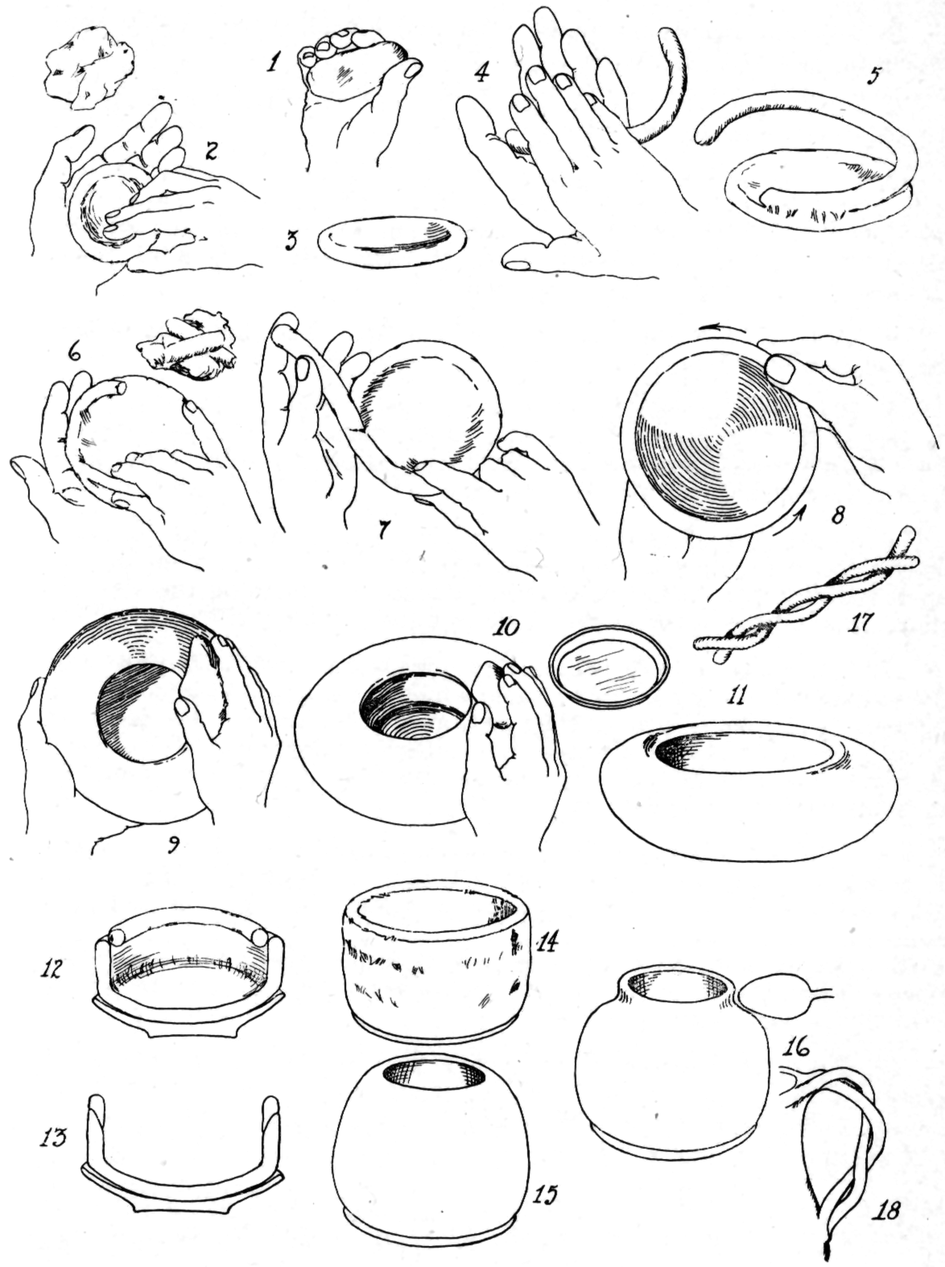
A clay and water mixture, the consistency of thick cream is known as slip. The proper consistency or density for slip casting is obtained when the mixture contains 10 ounces of dry clay to 16 ounces of water, or has a total weight of 26 ounces per pint. Clay, powdered or ground to pass thru a 200 mesh screen, (200 mesh per square inch), is best for both slip casting or modeling.

Modeling Clay

Pour slip into a dry plaster of paris mold, page 301, or on a plaster slab. As soon as the water has been absorbed by the plaster, collect the moist clay into a lump and shape into a cube by throwing it against the slab. Store in a covered container, (rust-proof metal or pottery jar), with a moist cloth over the clay.

Coiled Ware (Indian Method)

The procedure outlined on page 296 for Pottery making is that used by the Indian Potters in the Pueblos of the Rio Grande Valley, also those in the village of Tewa, First Mesa, Hopi-land, Arizona.



I. Modeling A Pottery Shape

A tempered clay body, as described on page 294, is required.

1. Take a handful of moist clay and knead it thoroughly with the fingers as indicated in Sketch 1.

2. Flatten the plastic clay into a disc and compress it into the palm of the hands as indicated by Sketch 2.

3. Form a slightly concave pad, Sketch 3, on which the coiled work is to rest (about 3/8" thick) and place it on a base which may be rotated. See Sketches 12 to 16. Table ware, china plates, enameled saucers, tin plates are used for this purpose today. Formerly a rounded pot sherd (broken pieces of pottery) was used.

4. Take another handful of clay and after kneading, roll it between the palms of the hands as indicated in Sketch 4.

5. Place this cylindrical shaped clay roll upon the base, as suggested by Sketch 5. Coil it around the edge of the disc, and with wet fingers press the coil into the edge of the base until a good bond results. Sketches 6 and 7, also 12 and 13, indicate the procedure.

6. Continue to add more coils of clay, being careful to keep the clay moist enough to adhere to the preceding coils. In forming a small pot, build up the wall a few inches at a time, adding and flattening the clay rolls or rings, rotating the work in the hand as indicated by the arrow in Sketch 8.

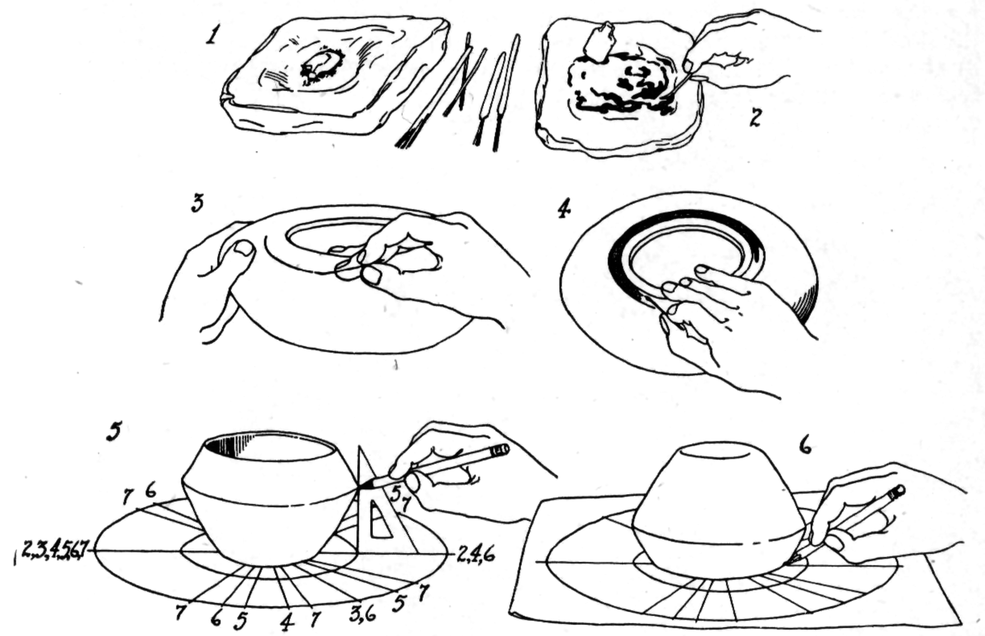
7. Shape the built-up coils to the approximate size and contour desired by turning the pot on the base, meanwhile smoothing and bending the wall between wet fingers and a shaping tool. See Sketches 14 to 16. Large pots are built up section upon section. Each section must dry sufficiently to sustain the weight of the next, but the top edge must be left moist enough to bond with the next clay roll.

8. Sand or scrape the surface of the partially dried "pot"; moisten it if necessary, with a piece of sand stone, as in Sketch 10, to reduce wall thickness and to equalize the uneven surface left by the fingers while molding it into shape. Formerly stone, sherd, or gourd rind scrapers were used. Today other tools have been added to the Potter's tool kit; spoon bowls, knife blades, door knobs, electric light bulbs, serve to scrape and smooth clay surfaces.

9. Polish the surface of the pot with a smooth stone until a uniform glassy surface is obtained. It will be necessary to apply water to the pot as the polishing stone will not burnish a dry surface. Permit the pot to dry slowly in a shady place.

II. Decoration of Pottery (Indian Method)

The "green pot", (name applied to air dried, unfired ware), is painted with *pigment, mineral and vegetable, which has been put into a water solution. The minerals, oxide of iron, manganese and other metals, in nodules (natural forms), are ground to powder in water or slip, (water with clay added for thickening), by rubbing them into a small stone mortar, usually a cavity in a flat stone, Sketch 1. The juice of the bee plant is concentrated by boiling and the thick syrup charred. This charred mass is ground into a water solution which produces the matt, or dull surface, designs on the black pottery made in the San Ildefonso, Santa Clara and Santo Domingo Pueblos in New Mexico.



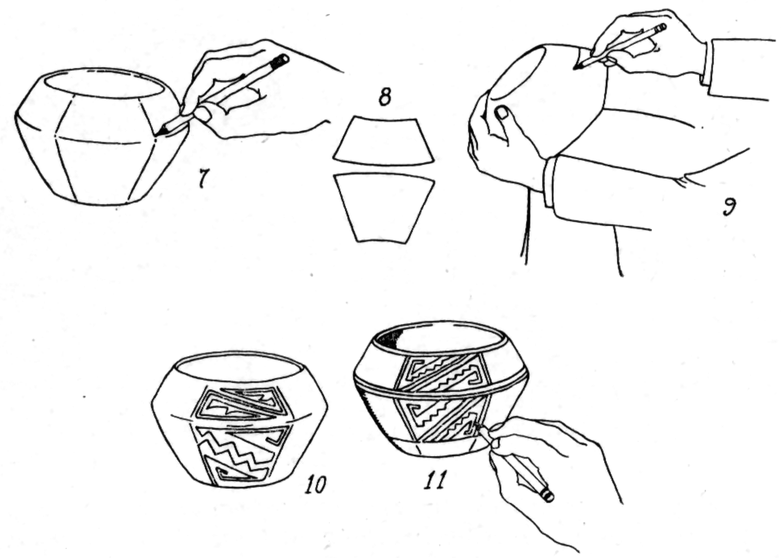
The pigment is applied to the pot with a brush or applicator made from Yucca leaves, Sketch 1. Short sections of the leaf are flattened at one end with the teeth and reduced to the desired width by stripping off part of the fibers. Sometimes turkey leg tendons are used for brushes. The width of painted line on the pot is controlled by the number of fibers left in the brush. The moisture absorbed from the pigment reduces the stiffness and adds flexibilty to the parallel fibers of this bayonet-like leaf. The brush, however, is not used like the ordinary commercial brush. The back and forth sweeping motion is not Indian technic. The fibres are charged with pigment by drawing the brush through the little pool of liquid toward the person applying the pigment to the pot, Sketch 2. Lines are worked on the pot by holding the fibre flat against the surface and drawing the brush from point to point in one direction, toward the person painting. This method of using these fragile tools produces very uniform width and density of line, also insures comparatively long life to the brush.

*White pigment is kaolin. Yellow, orange, red, brown are ochers—tinged with iron.

III. Design Layout

The painting of a pot is a rather ingenious technic of primitive origin. It is largely a freehand procedure. Areas are blocked out and marked on the pot with a pencil. Formerly charcoal or some chalky mineral was used. The size and number of the areas are sometimes laid out by sight, freehand, and again by the aid of a twig or piece of string as a measuring tool for transferring dimensions. A freehand stroke is sometimes made by pressing the elbow against the body, when crouched over the pot, placed on a knee. The lines are drawn from point to point as the body is straightened up. Unit areas where repeat designs are applied are frequently placed between border lines, scribed as shown in Sketches 5 and 6, page 297.

Here the boundary lines are drawn freehand using one or more fingers overhanging the edge of the pot to form a distance gauge and a support for the thumb and fingers holding the paint brush. As the pot is rotated the line is drawn. Sketches 3 and 4 indicate this procedure. This technic in the hands of a master craftsman gives most uniform results in width of line and distance from the edge of the pot.



Design areas like those indicated in Sketch 10 are filled in freehand. The design is outlined with lead pencil and then the pigment is applied. See Sketch 9. Any pencil lines remaining uncovered by pigment disappear when the pot is fired and hence do not have to be erased.

An alternate method of laying out design areas in units of 2 to 7 is indicated in Sketches 5 and 6. Points are transferred to the pot or bowl from the chart with a triangle and pencil as shown in Sketch 5. Corresponding points, top, middle and bottom are marked. The connection of the marked points with lines sketched freehand or along the edge of a flexible straight edge or ruler will enclose the unit areas to be decorated. This procedure is suggested by Sketch 7.

The pottery illustrated in Sketches 1 to 18 have been chosen to show several shapes and designs suitable for craft projects. They may be readily produced by any of the methods described in pages 294 to 314, and the decorations applied in the primitive way described on pages 297 and 298.

The first four pieces are reproduced from the Denver Art Museum collection. Nos. 1, 2 and 4 are Hopi. No. 3 is a Mimbres bowl. No. 5 is

from McDonald Canyon, Arizona. No. 6 is from Stone Axe, Arizona. Nos. 7, 8, 10, 13, and 14 are adaptations of shapes and designs taken from various sources. The other numbers are to be found in the collection of the Colorado State Museum. No. 9 is Pueblo, and No. 11 Hopi. Nos. 15, 16, and 18 are from Montezuma County, Colorado. No. 17 is from Chaco Canyon, Arizona.

IV. Cast Pottery

In contrast with the laborious hand craft of the primitive Indian method of coiling and pinching together clay to form pots, is the modern method of slip casting. Hand work is virtually replaced by mechanical devices. The simplicity of this method has resulted in its widespread use, where the slip casting method of pottery making is applicable. Not all kinds of pottery can be made by this method. Certain kinds of table ware—plates, cups, saucers, are made by other methods, described on page 309.

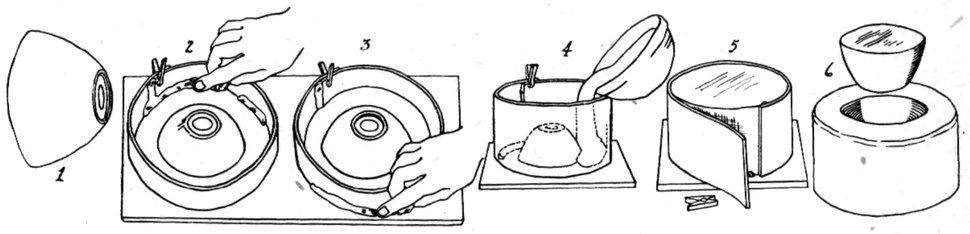
Hollow-ware, bowls, vases, are usually made by the slip casting method. A *mold made from Plaster of Paris somewhat larger than the finished article is required. The clay is mixed with water until it is about the consistency of cream, in which state it is handled as a liquid and known as slip to pottery makers. Plaster of Paris has the property of absorbing water readily.

A mold made of Plaster of Paris is filled with slip, which is permitted to stand for a certain length of time. The liquid clay next to the mold loses moisture through absorption of the water by the Plaster of Paris mold. A wall of leathery-like clay is formed. When the wall reaches the desired thickness the liquid clay enclosed by it is emptied out of the mold. This leaves a clay wall standing which continues to shrink away from the mold. After it is dried sufficiently to permit handling with safety, the pot is removed from the mold. Further drying is necessary before the pot may be decorated and fired. See page 297 for the decoration of pottery, and page 313-315 for the procedure in firing.

V. Mold Making

The shape of the article to be made of clay, also the amount of shrinkage the clay (usually a mixture of several ingredients, known as the clay body), undergoes in firing, must be known before a mold can be made to produce a piece of pottery of predetermined size. The usual practice in mold making is to start with a pattern (turned on a lathe) either of wood or of Plaster of Paris.

1. Place the pattern, Sketch 1, on a smooth surface, Plaster of Paris slab, glass, marble, metal or wood as indicated in Sketch 2-3.



2. Place about the pattern an enclosure. Pieces of glass on a Plaster of Paris slab are suitable for rectangular molds, see photograph, page 306 Another enclosure is made from a strip of linoleum as indicated in Sketch 2. This is recommended because of its simplicity. The band of linoleum is held together with a clamp. A spring type clothes pin makes a satisfactory clamp. Allow a 2″ or 2½″ space above and around the pattern.

*A mixture of 2.75 pounds of Pottery Plaster (U. S. Gypsum Co. brand) to one quart of water yields a strong, water absorbent casting, having a volume of approximately 75 cubic inches. The proportions of the mixture are 56.82% of plaster and 43.18% water. The hardness of the plaster casting may be controlled by varying the quantity of plaster in the mixture. A smaller quantity of plaster results in a softer casting, a larger quantity will be proportionately harder. It is a convenient factor to remember when computing the quantity of both ingredients that the volume of the casting is approximately 1.5 times the volume of water used in the mixture. A casting containing 37.5 cu. in. volume requires one pint of water and 1.375 pounds of plaster to yield a mixture having the proportions given above.

Soap size is used to prevent plaster sticking to surfaces. Into a quart of water place a piece of laundry soap the size of an egg. Simmer over slow heat until the soap is dissolved. The cold size should be the consistency of syrup and may readily be applied with a brush. No. 1 Pottery Plaster—not Molding Plaster.)

3. Seal the joint between the linoleum and the surface upon which the pattern rests with clay, both inside and outside the linoleum, see Sketches 2 and 3.

4. Apply a solution of soap and water (a linseed oil soap used for washing automobiles is very satisfactory) to all surfaces contacted by the Plaster of Paris.

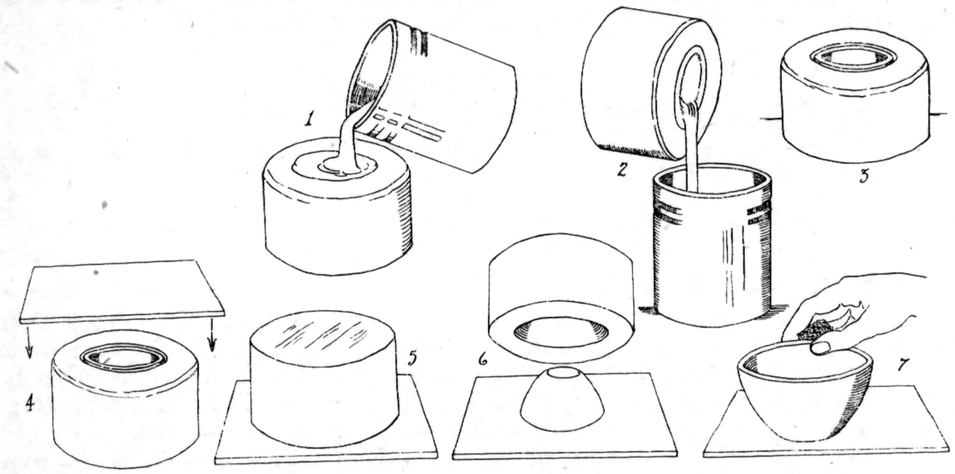
5. Mix the Plaster of Paris with water as follows: Fill a bowl or bucket of the required size about half full of clean water, preferably water which has stood long enough for the air bubbles to escape. Add the dry Potters' Plaster or Plaster of Paris to the water, either in small quantities by hand or by shaking through a coarse sieve (⅛" mesh) in to the center of the vessel. When the cone of Plaster of Paris reaches the surface of the water, but little more of the plaster will be required for the proper consistency. Stir the mixture vigorously with the hand and crush the lumps between the fingers until the mass thickens.

6. Pour the plaster in a steady stream into the space enclosed by the linoleum wall and allow the plaster to set, about 15 minutes, see Sketch 4.

7. Remove the linoleum as indicated in Sketch 5 and place the plaster mold on its base. Permit the mold to dry until the pattern is loosened. This occurs when the heat generated as the Plaster of Paris sets causes expansion. Remove the pattern as indicated in Sketch 6. Permit the mold to dry over night before using. Trim off any fins of plaster adhering to the edges of the mold. A useful tool for smoothing a mold is a small wood working hand plane.

VI. Casting a Piece of Pottery

The procedure of casting a pot in a plaster mold is outlined for the one-piece mold. This mold, depending on the size, might be either a bowl or a cup which is to have a pressed clay handle attached. It is assumed that the clay body has been obtained of the right consistency to pour readily.



1. Pour into the plaster mold sufficient slip, see Sketch 1, to fill the cavity. As the water in the slip is absorbed by the mold the surface of the liquid clay pool will recede, and the edge of the pool solidify. When the desired thickness of the solid clay is reached (⅛" to ⅜", depending on the use of the article cast) the remaining liquid clay is poured back in the slip jar, see Sketch 2.

2. Permit the mold, now lined with a layer of solid clay, to stand until the clay shrinks away from the mold as indicated in Sketch 3.

3. Remove the casting by placing a thin cover plate of ply wood or glass on top of the mold and turn the mold over while in contact with the cover plate, see Sketches 4-5-6. The mold may now be lifted off the cover plate releasing the casting. The casting should be permitted to dry until the leather stage is reached before handling to avoid marring its shape.

4. True up the edges and smooth out any finger prints or other blemishes with very little water applied to the leather dry pot with a wet sponge, see Sketch 7.

5. Permit the green pot to dry in a moist room if it is to be biscuited and later glazed, otherwise permit it to dry sufficiently for decorating as described on page 297.

The transition from bowl to a cup is effected by attaching a handle to the green casting. The procedure in making a handle follows. This process requires the use of another plaster mold but of a different type. Instead of shaping the handle by the process of slip casting previously described, a press mold is used. The cup handle is formed by pressing a small coil of clay into a cavity of the desired shape, contained in a plaster mold. The construction of a press mold is detailed below.

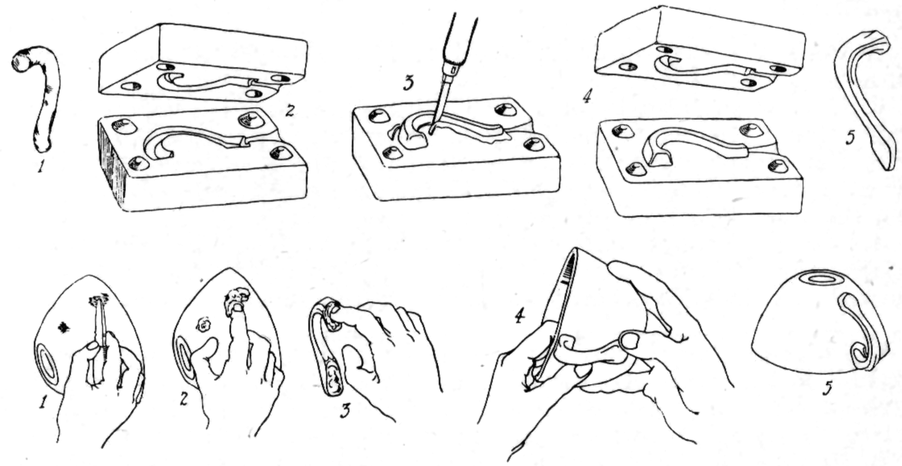
VII. Formation of a Cup Handle (Press Mold Method)

1. Place a small coil of clay, Sketch 1, into the cavity of a press mold shown in Sketch 2. Compress the clay by pressure on the mold. The mold will not close tightly if the quantity of clay is in excess of the mold capacity.

2. Open the mold and with a knife blade trim off and remove the excess clay which adheres to the partially formed handle, see Sketch 3.

3. Replace the mold (top portion) and compress again. Remove any excess clay as before. Repeat this process until the amount of clay just fills the mold cavity as indicated by Sketch 4.

4. Remove the shaped handle from the press mold, Sketch 5.



VIII. Application of the Handle to the Cup

1. Roughen the contact points on the cup with a knife or piece of abrasive paper, see Sketch 1.

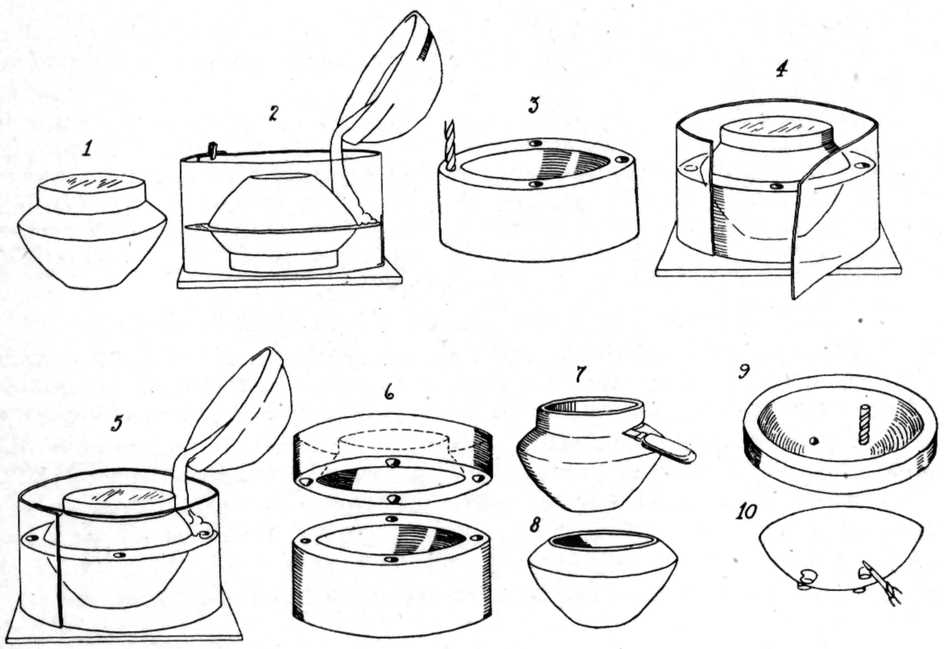
2. Cover these points with slip (liquid clay). Apply slip to the ends of the handle also, see Sketch 2-3.

3. Join the moist surfaces of the handle to those of the cup and bond them together by pressure with the fingers, see Sketch 4.

4. Allow the joint to dry before firing, see Sketch 5.

IX. Mold Making (Two-piece Mold)

The procedure for making a one-piece mold is described on page 301. Only such articles, bowl or cone shaped vessels, which may be lifted out of the mold may be cast in a one-piece mold. Vases, bottle shaped and squat-typed vessels, which have a diameter of a different dimension than either the base or top require a mold constructed of two or more pieces. The shape shown in Sketch 1, requires a two-piece mold.



1. Place the pattern, either wood or Plaster of Paris, upon a smooth surface as shown in Sketch 2.

2. Enclose the pattern in a strip of linoleum as described under steps 2 and 3 for a one-piece mold. See procedure given on page 301.

3. Fill in space between the pattern and the linoleum with modeling clay to a depth which corresponds to the largest diameter of the pattern. Level the upper surfaces of this clay.

4. Mix the Plaster of Paris as described in Step 5 and fill the space remaining between the clay surface and the top of the linoleum wall, as indicated in Sketch 2. After the Plaster has set, remove the linoleum wall, clay and pattern, Sketch 3.

5. Place the newly cast mold upon a flat surface and cut 4 holes, see Sketch 3, in the upper edge with a twist drill or counter sink. These holes are about 3/16" in depth, and serve to hold the upper portion of the mold in place. They are known as "joggles" to the pottery craftsman.

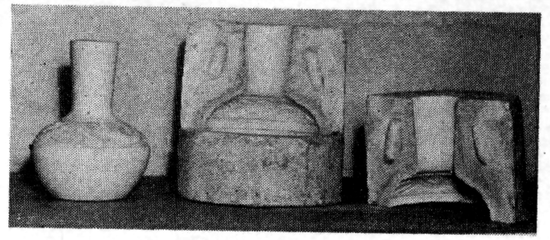
6. Replace the pattern in the Plaster mold and again set up the linoleum wall as indicated in Sketch 4. Apply a solution of soap and water to the surfaces of the pattern, mold and linoleum.

7. Cast the upper section of the two-piece mold in Plaster as described in step 5, page 302. Sketch 5.

After the Plaster has set, remove the linoleum wall and separate the mold. Sketch 6 shows the appearance of both the upper and lower sections of the mold. Note the four cone shaped points which were made to fit the holes drilled in the upper edge of the lower portion of the mold which insures both pieces fitting together accurately.

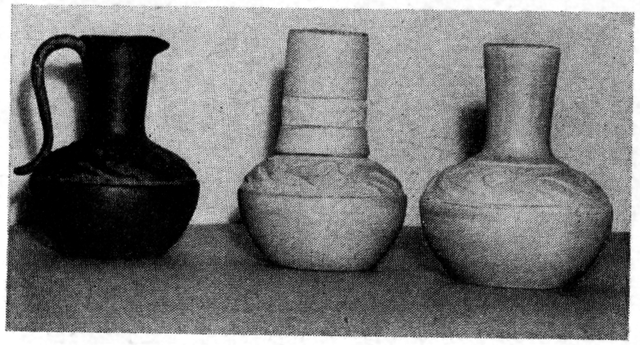
The casting of a bowl in the two-piece mold is done in the identical manner described for casting in a one-piece mold, see description, page 302. It is necessary, however, to hold the two parts of the mold together. The use of large rubber bands made by cutting strips across a discarded automobile inner tube is a prevailing practice. Two or more such bands will give sufficient pressure to hold the mold parts together during the process of casting.

In Sketch 7 the method of removing an excess of clay is shown. This portion of the bowl is purposely left longer than required for the finished article to allow for the shrinkage in the mold, and permit finishing the edge to a uniform height. See Sketch 8.



A B

A three-piece mold is shown in the photographic illustration, B. The pattern shown in A is made of Plaster of Paris turned to size and shape on a lathe. The incised decoration is made on the Plaster pattern with modeling tools before the plaster has become dry. The procedure for mold making is described on page 301.



D E F

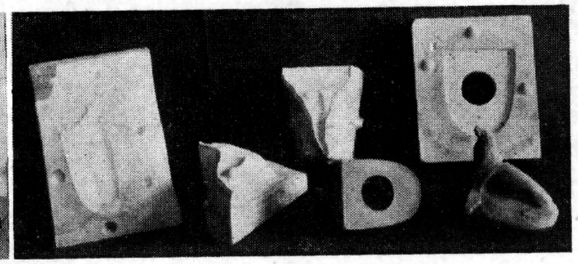
Illustration F shows a slip casting, made in this three-piece mold, which may be used as a flower vase, water bottle or lamp base.

Illustration D shows an adaptation of this shape with a handle and a lip added. Illustration E shows the casting which may be used for a water bottle and the cup as a cover.

The slip castings are fired (bisquited), then glazed inside for water proofing and decorated with a mineral oxide wash. The incised decoration shown on the piece illustrated is a modification of the "Plumed Serpent," a favorite motif of ancient Maya peoples as well as the San Ildefonso Pueblo potters.

The procedure described in the foregoing pages for making molds from a simple pattern, may be utilized for more intricate pieces. The Seal book end, Illustration C, is made in a five-piece mold. Illustration G shows this

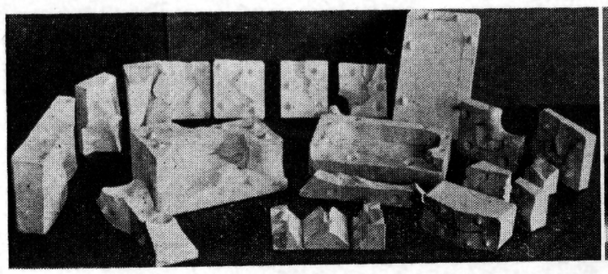
C



G

mold disassembled. An object of this type is appropriately made with a base, which is cast integral with the figure piece. The base is made hollow, the excess slip being removed by draining off through the center hole in the bottom.

The casting was fired (bisquited) in a small China Painter's kiln—temperature 1250 degrees F. with distillate oil fuel. A commercial glaze (Black) was applied to the bisquited casting which was again fired in the same kiln to a temperature of about 1950 degrees F. required to mature the glaze.



M

H

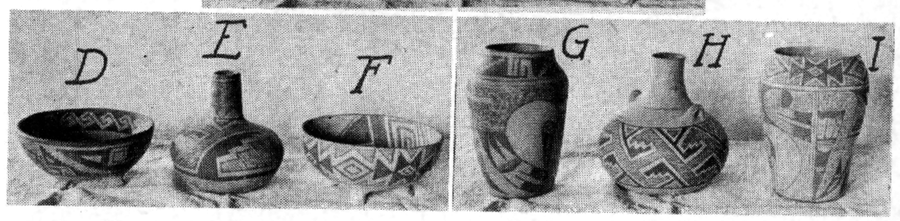
An object, much more intricate to cast, is shown in the photograph, Illustration H. The subject of this study made by Lawrence G. Heller, a local artist, was the statuette of a horse, **The Percheron.** Eight separate piece molds were required and each of these molds contained two to seven pieces. Each part was cast in the way described for slip casting on page 302. After removal from their respective molds the parts of the statuette were assembled in much the same way that a cup handle is attached to the bowl, see page 303. The assembled casting required a little touching up with modeling tools. It was then bisquited and later gloss fired as described above.

The photograph M shows the disassembled molds required for producing each portion of this statuette. The parts required are as follows: **Head**, five-piece mold; **Body,** seven-piece mold; **Tail,** three-piece mold; Base, six-piece mold; **Right Hind Leg,** three-piece mold; **Left Fore Leg,** three-piece mold; **Left Hind Leg,** two-piece mold; **Right Fore Leg,** two-piece mold.

The Potter's Wheel

Perhaps the most outstanding skill of the potter which has come down from ancient times is known as **"Throwing on the Wheel."** The equipment in its most elemental form consists of a vertical spindle with a disc or plate attached to the top and another mounted near the lower end as suggested by Sketch 1, page 308. This spindle is free to rotate and is set in motion by foot power. The potter presses his foot firmly against the top of the lower plate and pushes it forward as indicated by the foot outline, Sketch 2. The resultant motion resembles a kick of the foot, from which action the wheel has become known as the **Kick Wheel.**

To produce pottery shapes with such equipment is indeed an art of the highest order. It involves a knowledge of the plasticity of the clay, a sense of touch which enables the potter to find the critical speed, where the centrifugal forces are delicately balanced against the pressure of his hands. When all of the processes are nicely adjusted the slippery clay mass will yield to the combination of forces applied, and may be lifted to the desired height and pressed into shape as the wheel revolves. To keep the wheel turning at the proper speed for each process requires a rhythmic timing and a muscular coordination akin to that demanded of a musician at the console of the pipe organ. To produce pleasing shapes in clay by this method requires also a highly trained eye and an appreciation for the artistic combination of line, contour and mass. Truly the potter who has disciplined himself and perfected his skill in "throwing on the kick wheel" is an artisan and master craftsman worthy of the name. It is to be regretted that this picturesque and romantic process is yielding to other procedures which permit duplication and greater quantity of output.

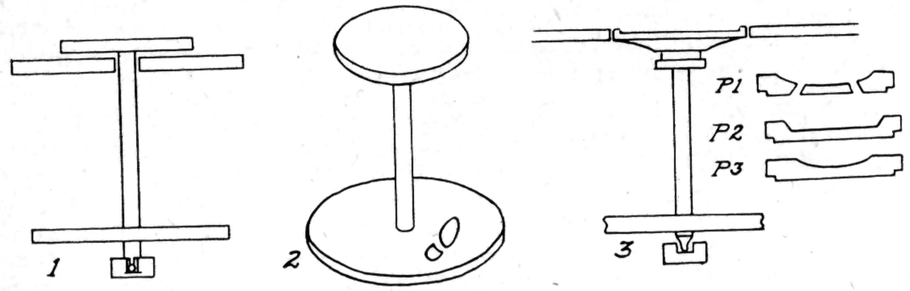


The pottery illustrated is the handiwork of our friend and fellow craftsman, Jim Breslin. He shares a common interest in making available to others some of the enjoyment experienced in assembling this information.

These pieces were all made by hand, using mainly the coil method, described on page 296. A rotating plate, Sketch 3 (made from old automobile parts), and operated by foot power (kick wheel method) was used as a base for shaping the built up clay as described on page 308. Three shallow Plaster of Paris bases made to fit the flanges of the rotating plate were used to support the clay while the pot was being shaped. Pots A, D and F were formed in Plaster base No. P-1. Pots B-G and I were formed in Plaster base No. P-2. Pots C-E-H were formed in Plaster base No. P-3.

Kick Wheel

Clay of the proper degree of plasticity was placed in the Plaster base and smoothed out by hand until it covered the Plaster surface uniformly. The clay yielded to the pressure of wet fingers and a porcelain door knob, while the plate was rotated slowly. The weight of the kick wheel (an old Model T wheel), which was keyed to the vertical shaft (old Model T



axle), supported by a thrust bearing below and a ball race above, was sufficient to give smooth rotation to the plaster base. It required comparatively few "kicks" on the rim of the kick wheel to keep the plaster base turning at a speed sufficient for the easy manipulation of the clay.

The coil method of building up the pot as described on page 296 was used in applying the clay to that previously formed in the plaster base. The procedure in shaping the pots by hand and with the bowl of a table spoon is described on page 295. The spocn bowl is an excellent tool for this purpose. It may be held concave point against the outside of the revolving pot to remove thin layers of clay, in much the same way that a cutting tool is used on a lathe, Sketch 16. When the convex point is held against the revolving pot a smoothing action results.

After the desired shape was produced, the edge and surface was finished with a wet sponge. The plaster base containing the green pot was removed from the flanged plate and permitted to dry to the leather hard stage. The absorption of water by the plaster base and the shrinkage of the clay in drying made the removal of the pot possible in about two hours' time.

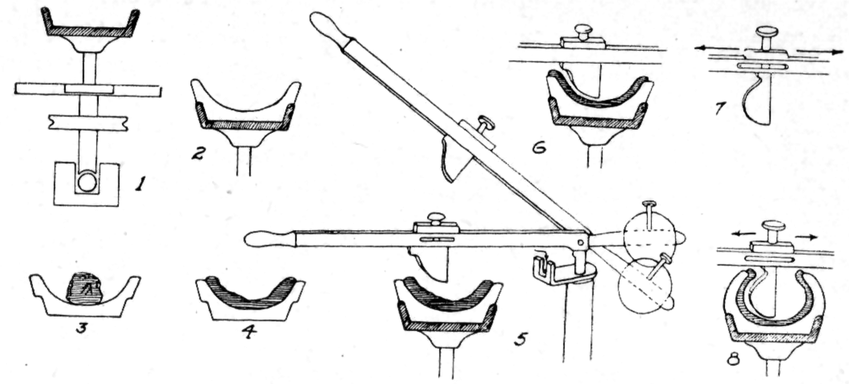
Shapes D and F were made in the Plaster base No. 1 which had been pierced with three holes equidistantly spaced. These holes were filled with moist clay before the inside of the plaster base was clay covered. When the clay shrank sufficiently to release the plaster base, the green bowl was turned out on a board as shown in Sketch 5, page 302. Before the clay hardened the three clay protrusions, made by the clay pressed into the holes drilled in the plaster base, were formed into feet of the desired shape and size with a knife and modeling tools. Shape H was equipped with two loops in the same manner as the cup handle was attached to the bowl. See Sketches 1 to 5, page 303.

Jigger Wheel

Another mechanism used for the production of certain types of pottery and definitely developed from the potter's wheel is the device illustrated in Sketches 1 to 8, known as the Jigger wheel.

This mechanism consists of a vertical shaft supported on a thrust bearing and rotated by a driven pulley or other device, Sketch 1. To the upper end

is attached a demountable metal plate, Sketch 2, into which detachable Plaster of Paris forms may be placed and rotated. See Sketches 3 and 4.



A weighted hand lever, Sketch 5, pivoted at a central point, is mounted on the work table behind the spindle. This lever is equipped with a movable clamping device into which may be inserted metal contour plates or profiles. When secured in the proper position with respect to the Plaster of Paris form, the profile plate distributes a ball of clay and reduces it to the desired thickness while the spindle rotates. See Sketch 6.

After the clay has been distributed in the plaster mold by the profile attached to the hand lever, position A, Sketch 5, the lever is returned to upper position by the action of the weight. This permits removal and replacement of the plaster forms. Before removal of a form the upper edge of the clay is finished with a wet sponge. The clay filled forms are set aside and permitted to dry until shrinkage releases the leather hard piece. These green pieces are removed in the manner described on page 302 for the removal of a bowl from a one-piece mold.

The "Jigger Wheel" described above is admirably suited for the production of bowl or cone shaped pieces. It may also be adapted to the making of other shapes where the top and bottom diameters are less than the diameter at the mid section. Sketch 7 indicates the wheel adaptation for a bulbous shape. A two-piece plaster form is required. The lower portion is placed on the plate of the spindle, Sketch 8. The upper portion is added and must be held securely in place by some suitable means. Large rubber bands may be used as in the case of slip casting in piece molds. This is suitable for experimental purposes. A heavy metal cover which rests upon the spindle plate is the means of holding together an assembled plaster mold in commercial potteries.

The clay placed in an assembled mold or plaster form is distributed by a profile as above described. The profile, however, must be carefully positioned after being placed inside the form as indicated in Sketches 7 and 8. This is accomplished by sliding it along the hand lever until it occupies the proper position to produce the desired wall thickness while the spindle rotates. To remove this profile it must be unclamped and moved along the lever until it can be lifted out of the top opening. After removing the plaster form from the wheel it should be handled in the manner described for molds in slip casting.

Primitive Firing

The air dried clay pots made by any one of the methods described are soft, fragile, and must be hardened if they are to be serviceable.

The primitive as well as modern method of hardening clay pots is known as firing. The Pueblo Indian practice of using an open fire is a hazardous procedure. In the village of Tewa, First Mesa, Hopi-land, the decorated green ware is placed in a pile upon broken pieces of pottery bowls, used for a ground covering. Similar pieces of broken fired bowls are used as covers for the green ware. This covering, crude as it may seem, affords protection for the pottery similar to that of the *sagger used in modern kiln firing procedure. In the Pueblos along the Rio Grande the firing procedure is similar to that in Hopi-land. The pottery is placed on a grate made from sheet iron, old corrugated iron, tin cans and other discarded sheet metal. The fuel is chiefly dried dung (caked sheep and cow manure) which is heaped over the pottery and held in place by stones and pieces of sheet iron. Native pottery makers must exercise the greatest care with the primitive open-fire method. Insufficient temperature results in semi-hard under fired ware. Discoloration results when the fuel contacts the ware. Cracking and spalling (flaking off) is caused by too rapid firing or sudden cooling.

In any event there is a critical temperature and time period for: dehydration (the driving off of moisture), oxidation (the effecting of chemical change between elements making up the clay body), and the maturing of the ware. The control of these factors in the open, where the effect of wind, uneven thickness of fuel, radiated heat loss, all make the firing process very uncertain and a final test of the Indian Potter's skill.

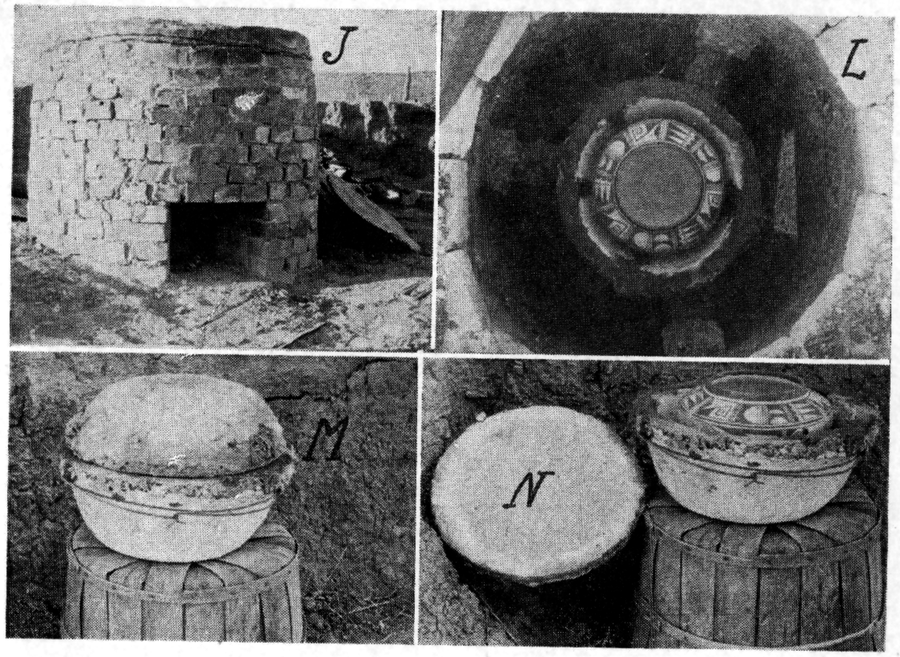
We hope that our Indian friends, in the pueblos of the Rio Grande and in Hopi-land, who graciously assisted us by demonstrating their methods of pottery making, may receive some benefit from the record of modified procedure which we have found to be practicable in our experiments as presented in this chapter.

Brick Bat Kiln

In camps where Indian Lore is embodied in the activity program, a camp fire ceremonial can be built around this pottery firing process. To insure a greater degree of success in this ceremonial an improvised kiln is required. It may be constructed with "brick bats," pieces of broken fire clay bricks, available in nearly every community where old steam boilers have been used. When used with a handmade sagger, which protects the contents from gases and dust, satisfactory results may be obtained. It is possible to include in this sagger some small articles made by each camper who has created and decorated some piece of pottery. His interest and the joy of anticipation can well be imagined as he awaits the opening of the kiln.

The decorations on the shapes, page 307, were applied in the primitive way to the green pot, see Sketches 3 to 6, page 297. The pigment used was iron oxide, ground in a small mortar with water to which glue and a little glycerine had been added, which gave the mixture sufficient body to flow readily from a hand made brush. The decorated pots were fired in the brick bat kiln shown in the photograph illustration J. Illustration L shows the appearance of the inside of the brick bat kiln with the sagger placed on the support in the kiln. The cover is removed, showing the decorated bowl within the sagger. Illustrations M and N show the sagger containing a large decorated bowl ready to be placed in the kiln for firing.

Brick Bat Kiln



Sagger Making

Saggers are containers in which delicate pottery pieces are placed for firing to insure protection from dust and gases in the kiln. These are made from a mixture of equal parts pottery slip and "grog" (pulverized fire brick).

Two pieces were formed by pressing the clay body into molds. A wooden chopping bowl served as a mold for the cover and a metal dish pan (same diameter as wooden bowl) for the lower portion. The clay wall was about one inch thick. After drying, the green sagger was turned out as described in removing a green pot from a one-piece mold, page 302. The sagger was air dried, oven baked, and then used for the biscuit firing of a pot.

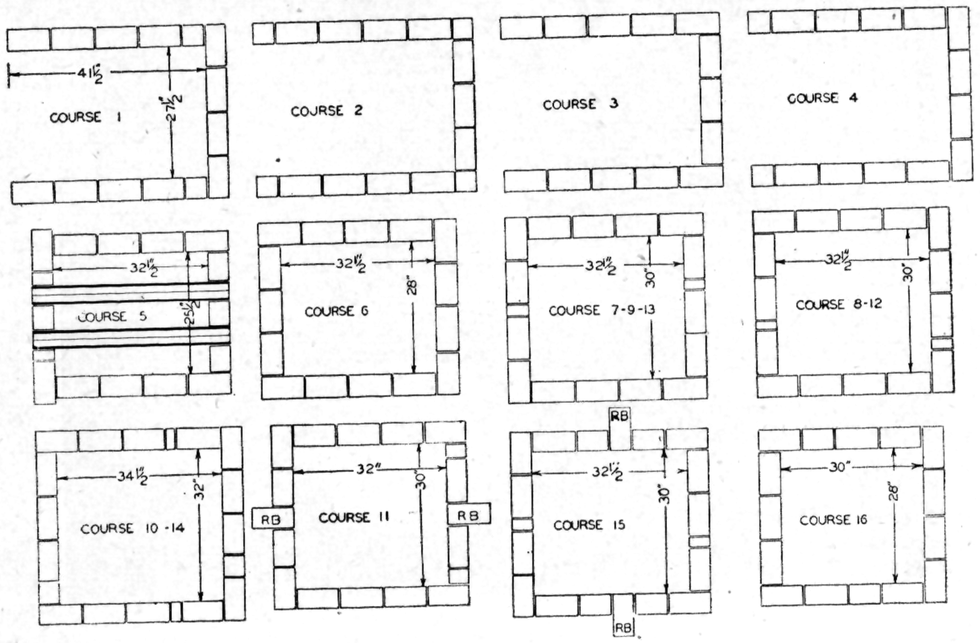
A Camp Kiln

The kiln described is designed to provide facilities for both bisque and glaze firing of pottery. The size may be adapted to the requirements of a class and capacity provided according to the foundation base area as described under construction detail.

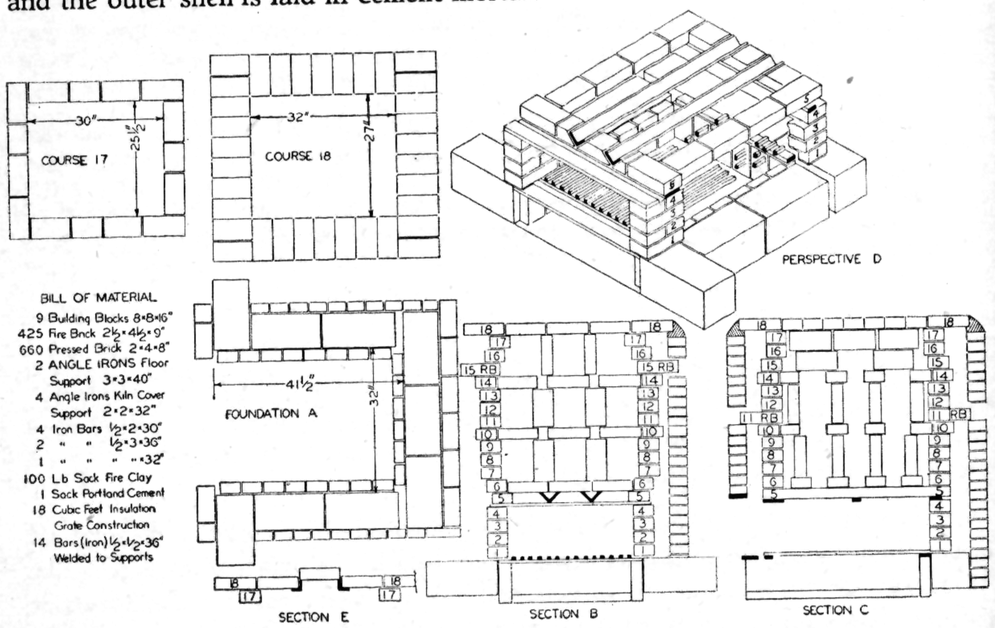
This kiln is a fire brick lined oven enclosed in a common or pressed brick shell, with insulating material used to fill the space between. The form may be rectangular or square and the top reduced to the dimensions given. The cover is made of a layer of fire brick in three sections of seven brick each. See course 18, section B and C. Special shaped brick are not required. The grates and floor supports may be made of junk metal. Mica sheets or fire resisting glass windows thru which the condition of the kiln

A Camp Kiln

during a firing may be observed. can be set into the openings made by taking out the removable bricks indicated as RB in courses 11 and 15. The fire brick



lining should be laid in a fire clay mortar, (a mixture of fire clay and water), and the outer shell is laid in cement mortar.



Since all loading of the kiln is done thru the top opening, it will be found advantageous to provide a plank walk around the kiln about two and one-half feet above the ground, so that articles on the kiln floor may easily be reached. Cinder blocks or other supports may be used.

Kiln Construction Detail

1. Sketch A is the foundation which may be built on the ground or on a concrete slab. It consists of nine cinder blocks 8"x8"x16" placed in the position indicated and lined with fire brick set on end to form the ash pit. The kiln cross sections transverse, B and C, sectional, show the construction of the fire brick lining, and the outer pressed brick shell.

2. Sketch D shows a grate made of ½" square iron rods welded to the two supporting rectangular bars ½" by 2" by 32". Perforated sheet metal or heavy screen wire, ¼" size with 1" mesh, may also be used and supported in the same manner. This grate is not built into the outer brick work, but rests on the inner bricks of the foundation, so that it may more readily be replaced if burned out.

3. The construction of the fire brick lining is shown in the sketches of the courses 1 to 18. The capacity of the kiln, which is shown drawn to scale is approximately 15 cubic feet. This may be increased by lengthening the kiln. Nearly 5 cubic feet capacity will be gained per brick, (nine inch), added to each side.

4. The sketch, course 5, indicates the method of placing the two pieces of angle iron, 3"x3"x40" which support the brick kiln floor. See also the perspective drawing D. The angle irons rest on transverse supports. The front support is a flat bar ½"x3"x36" and the rear support is ½"x2"x24".

5. In courses 11 and 15, the two bricks marked RB, (removable brick), are laid in place, (dry), without any mortar, so that they may be replaced later by windows. The construction is continued following the brick positions given in courses 1 to 9 as shown. This gives a vertical wall to the inside of the kiln. Course 9 forms a protruding ledge on which a shelf may be supported, as course 10 is recessed as shown. Course 13 is made a ledge in the same manner.

Method of Firing

Bisque Firing. Place the dry, "green pots" in the kiln on the floor and shelves. They may be closely nested or stacked without damage during this first bisque firing. Build up a wood fire on the grate until about a three-inch depth of glowing coals is produced. Then add coal or a mixture of coal and coke, evenly distributed over the fire to a depth of 1 inch. This will take 10 to 12 pounds. Continue firing at 15- to 20-minute intervals with the top opening uncovered until the kiln interior begins to show a dark cherry red color. This will require about two hours.

Close the opening in the ash pit with fire brick, leaving one or two brick out until the last quantity of coal is added. In all about 100 pounds of coal, or a mixture of 50 pounds of coal and 25 pounds of coke will be used. After the last charge of fuel is added, close up the fire door with fire brick, and cover the top except the space which one brick would occupy. This ventilation is necessary to insure complete combustion. When the fire is burning without smoke or volatile gases, close up all draft in the ash pit and cover the top completely. Leave the kiln undisturbed overnight.

The three rows of cover brick may be supported on angle irons as indicated in section sketch E. This form of cover support may be used in bisque firing only since the high temperature reached in glazing will cause angle irons to soften and sag under the weight.

Glost or Glaze Firing. 1. **After applying the glaze** according to the manufacturer's instructions, place the glaze covered pieces, which have previously been bisque fired, in saggers. Contact with the sides must be prevented and supports or stilts are necessary. These are available from the ceremic supply dealers listed. Place the saggers in the kiln, filling up all the available floor space. Stack the other saggers upon the first layer, placing this and succeeding layers so as to permit an even distribution of the heated gases around and under each sagger as far as possible.

Glaze Firing

2. **When the kiln is loaded** to capacity place the temperature cones in position to be viewed thru the windows. Lay the cover bricks in the position indicated, resting on the brick supports. They also may be carried by the saggers.

3. **Build the fire as directed under bisque firing** and when it reaches the bright cherry red stage supply additional air under the grate with a bellows of the blacksmith forge type, slowly and intermittently until the temperature color shows a light yellow color. Replenish the fuel in the fire box and when it has reached full combustion, (the incandescent stage), close up the ash pit door by bricking up the opening, leaving the air supply pipe from the bellows in position. Continue to pump the bellows and as soon as smoke ceases to rise cover the top of the kiln with a double layer of fire brick, except a vent about the size of ½ brick. Continue to supply air until the temperature cones collapse indicating that the required temperature to mature the glaze has been reached. This will take 4 to 5 hours after the fire has been started. Leave undisturbed overnight.

4. **"Drawing" the Kiln** may be done in about 12 hours or when the temperature has been reduced until the cover may be removed by hand. Remove about ½ of the cover only, then open up space in the fire door by removing two or three fire brick. After 20 to 30 minutes of air circulation thru the kiln, remove the balance of the cover and the fire door brick. As soon as the saggers can be handled comfortably set them outside to cool to body temperature before removing the covers.

GLAZES

***Ivory Cream Matt Glaze.** Cone .03 to .04, 1994 deg. F. to 1958 deg. F. White lead 375 grams, Kaolin 210 grams, Feldspar 100 grams, Flint 200 grams, Whiting 105 grams, Zinc Oxide 25 grams. A green shade results by adding Copper Oxide, 40 grams, and a brown shade is produced by adding 35 grams of Iron Oxide.

***Transparent Glaze.** Cone .012, 1580 deg. F. Lead Oxide (Litharge) 58 parts, Flint 35 parts, Kaolin 7 parts. Grind and screen through 100 mesh. To color this glaze use: 0.3 percent Cobalt Oxide—**Light Blue;** 0.5 percent Cobalt Oxide—**Medium Blue;** 1.0 percent Cobalt Oxide—**Dark Blue;** 0.1 to 1 percent Chrome—**Light to Dark Green;** 0.5 to 6 percent Copper Oxide—**Light to Dark Green;** 1.0 to 8 percent Iron Oxide—**Bright to Gold Yellow;** 1 to 5 percent Manganese Oxide—**Brown to Violet;** 1 to 3 percent Nickel Oxide—**Yellow Brown to Olive Green,;** 3 to 15 percent Uranium Oxide—**Orange Red to Tomato Red;** 10 percent manganese plus 1 percent Cobalt Oxides—**Jet Black;** 1 percent Antimony Oxide—**Yellow.** These colors may be used in a fritted glaze. This glaze may be made opaque by adding 10 to 15 percent Tin Oxide.

*A "Running Glaze," to be used over an opaque, previously fired Tin Glaze, is made from Red Lead 75 parts, Flint 20 parts, Kaolin 5 parts. Apply to top of piece and permit it to flow over previously glazed surface.

†**Copper Luster. Cone** .011, 1680 deg. F. Cornish Stone 15.1 grams, Flint 5.1 grams, Red Lead Oxide 35.25 grams, Manganese Oxide 6.25 grams, Copper Oxide (red), .75 grams, Cobalt Oxide .07 grams.

†**Golden Amber.** Cone .014, 1526 deg. F. Lead Carbonate 74 grams, Cornish Stone 15 grams, Flint 13 grams, Orange Oxide Uranium 4.0 grams.

†**Cherry Red.** Cone .05, 1922 deg. F. Lead Carbonate 38.7 grams, Oxide of Zinc Calcined 4.05 grams, China Clay 38.7 grams, Flint 102 grams, Bentonite 5.3 grams, Tin Oxide, 2.68, Soda Ash 84.8 grams, Silicon Carbide .8 grams, Copper Carbonate .8 grams.

Used on Gladding McBean & Co. Pottery Clay No. M442.

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*Eric Hellman & Co. Pottery, Colorado Springs, Colorado.

†Mr. Joe Lukins, Instructor, Central High School, Kansas City, Mo.

Instruction—Method A.

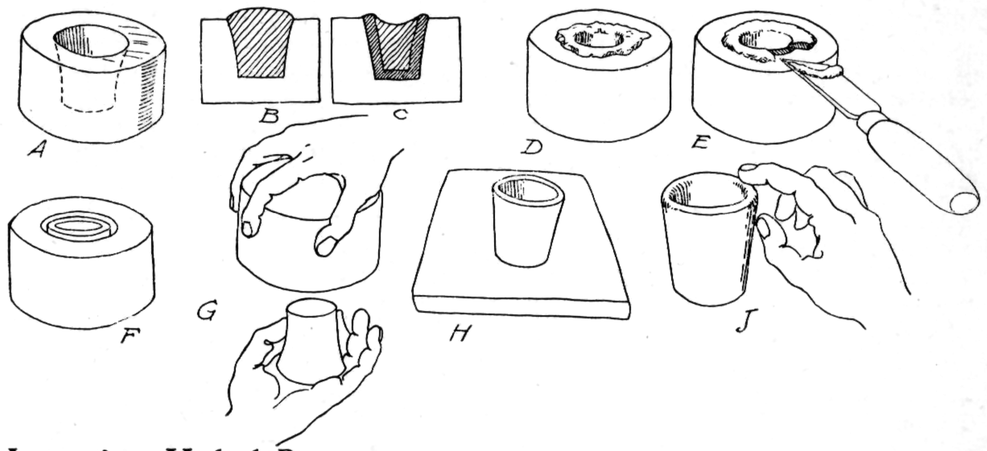
1. Pour slip into a plaster mold, Sketch A, below. Fill the mold until the slip rises above the top of the mold, see Sketch B. Permit the slip to remain in the mold until a wall thickness of about ⅛" is formed. Sketch C shows the appearance of the mold after standing about 10 or 15 minutes. The loss of water absorbed by the dry plaster mold is indicated by the position of the level of the slip which has sunk below the surface of the mold.

2. Empty the remaining slip into a container, and save for later use. Slip taken from plaster molds has lost water and should not be put back into the prepared slip as it will thicken the entire lot. Save it until enough slip has accumulated and then restore to the desired consistency by the addition of water and water glass (sodium silicate), to replace the liquid absorbed in the mold. Permit the mold to stand until the remaining clay hardens, about 10 minutes as indicated in Sketch D.

3. Trim the hardened clay away from the top of mold, see Sketch E, and permit the mold to stand until further water absorption occurs and the clay cup has shrunk enough to become detached from the plaster mold. See Sketch F.

4. Turn the cup of the mold as indicated in Sketch G and place it on a plaster slab as shown in Sketch H.

5. Smooth the shap edges on the leather hard cup with a wet sponge or finger dipped in water as indicated in Sketch J.



Instruction—Method B.

1. Flatten a ball of clay on a marble slab (piece of plate glass or metal covered table top), with the hands and a smooth cylindrical roller. (A table water glass or a bottle make good rollers). Work it out to a thickness of 1/8" to 3/16" as indicated in Sketch A.

2. Cut a strip of clay, Sketch B, width of the space H on the mandrel, and long enough to wrap around the end as shown in Sketch C. Apply soap solution to the dry mandrel and cover with clay as shown in Sketch D.

Moisten the contacting edges with water and press both surfaces together to form a bonded lap joint. Cut a disc of clay and attach it to the end of the cup being formed on the mandrel, Sketch D. Moisten the contacting surfaces with water and pinch the disc and wal of the cup together with the fingers.

3. True up the wall thickness on a hand lathe shown in Sketches E and F. Rotate the mandrel by hand while pressing the blade of the skiving knife, supported by the tool rest, against the clay to scrape off any excess. Continue this operation until the desired wall thickness is obtained. True up the base of the cup in a similar manner.

4. Mark decorative bands on the cup by pressing the point of a lead pencil or sharpened stick against the clay as it is rotated in the lathe. See Sketch G for suggestions in groove decorations.

5. Remove the cup from the mandrel, Sketch H, and smooth off the sharp edge with a wet sponge or finger.

6. Dry the cup in air on a plaster bat, Sketch H. over night.

Decoration of a Cup

1. Paint the air dried cup "green pot" as the unfired clay article is designated, with metalic oxides as described on page 297 and "bisque" fire in a kiln to cone .04. See temperature ranges for kiln firing, page 314.

2. The green pot also may be decorated with under glaze colors, glazed and fired in a "ghost kiln," see page 314 for temperatures required to mature glazes.

Suggestion for Mounting Cup

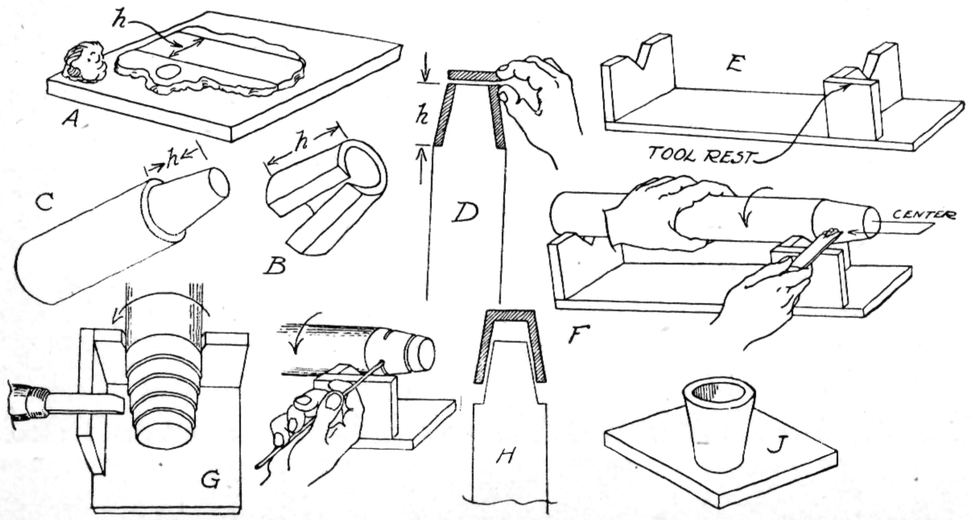
An inexpensive base to hold the match cup may be made from remnant pieces of wood. Any piece of wood ¾" to 1" thick and 2½" to 3" square is suitable for a base.

Drill a hole 1" in diameter through the block. Shape the block to suit individual preference. Wood blocks shaped in a lathe, turned from colorful woods; cedar, redwood, walnut, mahogany, etc., will give the project commercial value. Wood blocks whittled into irregular shapes with knife cuts showing, have been proving popular.

Frequently a space for attaching an abrasive surface required for striking matches is left on the block.

Safety matches of the paper stem variety are available in coiled bundles of assorted colors. However the wooden stick matches may be used in this match cup.

The construction of a container integral with the base to receive burned match sticks makes this project an interesting problem in desgin using wood, metal or plastic.



Tile

Examples of Hand Decorated Tile and Plaques made in Monterrey, N. L., Mexico.

Tile Making

Use a porous clay body for tile to avoid warping in the glazing operation. A suitable clay body may be made of the following ingredients. Six parts slip—three parts grog, 20 to 40 mesh powdered firebrick and bisque pottery—one part flint.

Roll out a sheet of clay to a thickness of about ⅝", cut to size with a "taut wire cutter" and bisque fire. Add about ten percent of pigment to a slip body and outline the design with the colored slip paint. Use a rubber bulb applicator. The colored slip is forced through a nozzle tip attached to the bulb, as indicated in Sketch A, Fig. 2. Fill the areas between the raised border lines with slip containing glaze colors.

The plaque of the Caballero riding his Caballo is an interesting piece since both matt and gloss glazes have been used to bring out the highlights in the sleek black hair of the horse.

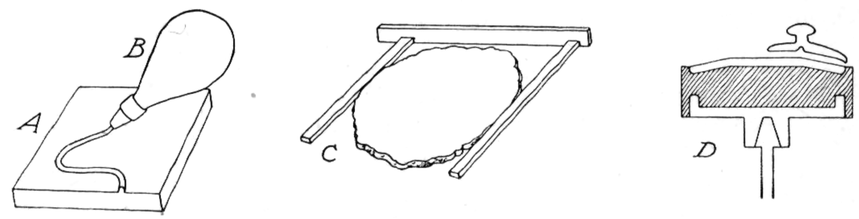


Fig. 2

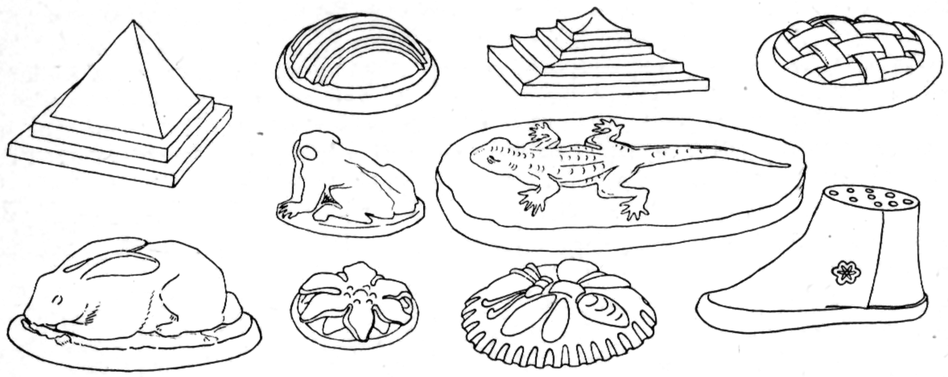
"The Potter's Craft," C. F. Binns, D. Van Nostrand, New York City.
"Pottery," Geo. J. Cox, The MacMillan Co., New York City.

The group of pottery pieces assembled in the photograph are part of a collection gathered from different parts of the United States. The Rebecca Pitcher and Candle holder are from potteries in the Smoky Mountains. The decorated plate is from San Antonio, Texas. The pitchers are from the Rushmore Potteries, Rushmore, S. D.

Plate Making

The plate shown above is made from dehydrated slip, which has been flattened on a slab, as indicated in Fig. 2, Sketch C. The thin sheet about 5/16" thick is spread on a plaster mold. See Sketch D, page 317. The bottom is shaped with the templet to form the rim and control the thickness. Apply a colored slip decoration described in the foregoing paragraph.

Suggested Shapes for Modeling



Several suitable shapes are suggested for molding and for mold making subjects. The miniature Navaho Moccasin is appropriately used for a Salt and Pepper container.

SOURCES OF SUPPLY:

L. H. Butcher Co., 2034 Bay St., Los Angeles, California—Ceramic and Chemical Items.
Gladding McBean & Co., 2901 Los Feliz Blvd., Los Angeles, California—Pottery and Modeling Clay.
American Art Clay Co., 4717 West Sixteenth St., Indianapolis, Indiana—Clays, Glazes, Pottery Supplies.
E. I. du Pont de Nemours & Co., Perth Amboy, N. J.—Glaze Colors.
Denver Fire Clay Co., Denver, Colorado—Kilns and Accessories.
Rushmore Potteries, Rushmore, South Dakota—Clay.

Primitive man's existence was made more secure when he discovered that a mechanical device for shooting his spear could be made out of wood and sinew with his own hands. Just when the use of the bow began, is lost in antiquity, but the presence of flaked arrowheads found in glacial debris indicates that the art of making bows and arrows, and skill in their use, dates back to an early epoch in the stone age.

Recently a mastodon skeleton containing a Folsom point was unearthed, and perhaps the archaeologists or geologists will determine from this the period of time when the animal and his primitive hunter, the Folsom man, may have lived. The Folsom arrow point or head was flaked with a concavity along the center line, an art apparently lost.

The historical background of Archery affords opportunity for investigation in a field rich in romance. Exploits of super men, their feats of archery as recounted in stories of the chase, in contests at tournaments or in battle, are fascinating to any audience, but especially so to a group on the archery range or around a camp fire.

The Egyptians were the first people of ancient history famous for their archers. For centuries the bow and arrow was relied upon as a weapon in war. In biblical times the Israelites used a bow "of reed, wood and horn" mentioned as "somewhat shorter than a man" with arrows 24" to 32" in length. The Greeks and Romans were not skilled in archery, and in their legions used archers supplied by Cretians and Asiatics. Famous for their skill and military prowess in the service of the Romans, the Persian, Scythian and Parthenian bowsmen added greatly to the glory of the legions in battle. The Roman horse archer, or mounted bowsman came into prominence with weapons effective even against armor in 378 A. D.

Horse archers were employed by the English during the 10th Century and in the Crusades, but the cross bow, with which missels of heavier weight and greater accuracy could be shot was the weapon with which the Crusading bowsmen overcame the Turkish and Egyptian Horse archers.

The short bow seems to have originated in the Scandinavian countries—"a short bow drawn to the chest" such as was used in the battle of Hastings, 1066, by the celebrated Norman archers with William the Conqueror. The English archers for a time retained the short bow, then the Welsh and the Irish developed the long bow for long range shooting, which proved its worth at Falkirk, Agincourt and other famous battles of the 14th Century.

For over two centuries the long bow was one of the principal arms of the English soldier, and the English infantry of archers the most celebrated in Europe, disappearing only about the time of the Armada in 1588.

Recent research and a *translation of portions of an original book by the Turkish archer craftsman, Mustafa Kani, discloses the interesting fact that during the same period as the English development of the long bow, the Turks achieved a record in flight shooting with their composite (sinew, wood and horn), bow which proves its superiority. Aside from its use in warfare, among Islamic peoples, archery had a religious significance and it was used in various rites and ceremonies. As a sport it was sponsored and encouraged by the Sultans of the 14th and 15th centuries, who themselves were famous archers. The Archers Guild, whose records are preserved in the writings of Mustafa Kani, flourished in Constantinople for four centuries.

It has been said that "all kings were of the same opinion in the matter of archery," and its use in sport was encouraged in England by the Crown with prizes and badges bestowed upon the "Fraternities of Archers" which later, in 1847, combined to form the "Royal Society of Archers" which has endured until modern times.

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*"TURKISH ARCHERY AND THE COMPOSITE BOW," by Paul E. Klopsteg, published in 1934 in a limited subscription edition, this book is a "Review of an Old Chapter in the Chronicles of Archery and a Modern Addendum."

ARCHERY

The available literature on the English long bow of "self yew," the Turkish reflex bow of sinew, wood and horn, the seven foot Asiatic bow of bamboo which shot an arrow thirty-six to forty inches long, the short sinew backed flat bow of the American Indian, all makes fascinating reading of general interest to the Craftsman.

Archery makes a two-fold appeal; to the craftsman and to the marksman. The construction of bows, arrows and accessories by a group, club or family unit, as well as an individual, affords handicraft opportunities of the highest type.

In archery the objective is to "make a bull's eye." The ancient term "pete centrum," (hit the center), was preserved in the use of the initials P. C. in the insignia of the old English Archery societies. This requires rigorous technique, a special coordination of muscle, nerve, and eye, as important to man today as they were essential to primitive man. There is fascination for the beginner when a score permits competition with himself in the effort to progress in steadiness and coordination. The wholesomeness of this out of door sport may be experienced at several age levels and it may well become a leisure time pursuit for the whole family.

Tradition and custom have dominated the archers of each country to such an extent that the rule of thumb has pretty largely governed the design and construction of archery equipment for centuries. To some archers it may sound almost a sacrilege to mention bow efficiency or suggest an improvement on the mighty bow of Robin Hood's time. Yet this has been the accomplishment of the decade just ended.

Through a scientific approach, bow efficiency has been increased from a 50 to 60 percent average to a 70 to 90 percent possibility. The ultimate in a bow or the 100 percent efficient bow is one in which all energy input may be converted into an equivalent energy output.

The enjoyment of Archery has been greatly enhanced by the application of engineering principles to bow design. Thanks to a few scientifically minded men who made Archery their hobby, and carried their scientific knowledge and skill into this handicraft as an avocation, we now have a technique in bow design which produces uniformly good results. The requirements of a bow were analyzed and a theory outlined, then bows were built and their performance measured with precision.

These scientific studies were reported in the two publications devoted to Archery, Ye Sylvan Archer, and The Archery Review, and appeared at intervals over the period 1929 to 1935.

In July, 1935, some forty articles were reviewed by Dr. Paul Klopsteg, who wrote a monograph on, "Science Looks at Archery," which was published by the Archery Review. A separate bulletin, No. 1, contains this resume, also an article by the same eminent engineer on, "Making a Bow with Rectangular Limbs." In a later edition of the Sylvan Archer, June, 1939, Dr. Klopsteg made a notable contribution to Archery in his article, "A Graphical Method for Bow Design," which will be presented as an Archery Project with his express permission.

As a scientific craftsman and historian, Dr. Klopsteg has done an outstanding job in research, and in a remarkably clear and interesting way has interpreted his technical findings to the average archer. Moreover, he has evidenced the never failing mark of a true craftsman by making this information available for the advance of the royal sport of Archery.

Another co-worker, archer enthusiast, scientist, craftsman, is Dr. C. N. Hickman. His research has contributed much toward clarifying the present knowledge of Bow and Arrow performance.

We are happy to give publicity to these fine contributions by Archer craftsmen, and to acknowledge a debt of gratitude for them, as well as personal appreciation for the privilege of presenting Dr. Klopsteg's "Graphic Method for Designing a Bow."

Bow Specifications

The construction of the best **bow** a stave will yield, with the **qualities which assure "proper action,"** we consider the objective of every archer craftsman. A bow laid out by the **graphical method** will be found to possess these qualities; it will **be well balanced, shoot without jar, propel arrows that are suited to it without interference at the arrow plate** and **have a cast which is maximum for a given drawing force.**

The preferred cross section for a bow limb has been found to be a rectangular section. This places the neutral axis midway between the belly and the back of the bow for equal tensile and compressive strength in the outer fibers, when the bow is flexed. Other cross section shapes, which bend in uniform circular arcs, possess this property, but a rectangular section with uniform limb thickness and graduated tapering sides, has a higher restoring force in relation to its effective mass.

The **graphical method** gives the rectangular cross section at designated points. Since the rectangles are designated for a bow of uniform limb thickness, the widths only are of variable dimension, growing shorter as the nocks are approached. See Fig. 1, p. 322.

The amount of taper between points 1 and 8 is obtained by connecting the width marks between points. The bending moments for each unit area, at every section of the limb, are equal when the bow bends in a circular arc. This condition of "dynamic balance" permits the limbs to move through their respective arcs of travel from full draw to the braced position in precisely the same time, and transmit equal impulses through all their respective sections from the string to the arrow.

Principle of Bow Design

We have selected our "root" cross section at point D, and we want to know the proper cross section at other points, 1 to 9. So we have drawn lines through point D—also points 1 to 9 perpendicular to the bow string. These distances are marked d_R distance from "root" point D to string and d_1 to d_9 distances from other points to string.

The tension in the string is the same everywhere. Call it force f. The mechanical principle, force x distance or "torque" as it is called, produces bending at each point. We wish to produce equal bending at each point. Since the thickness of the limb is uniform the areas of the limb at each point are in direct ratio to the width of the limb at the points. Let W_R represent width at "root" cross section point D. W_1 the width at point 1. We may write $f \times d_R / W_R = f \times d_1 / W_1$. This equation states that the torque per unit area (width x thickness) at "root" of limb must be the same as the torque per unit area at point 1 or any other point. Simplify the equation by cancelling out f, and write $W_1 = \frac{W_R \times d_1}{d_R}$. Hence the width of limb at any section must be proportional to the perpendicular distance of that section from the string. In terms of the maximum width at D originally selected by the designer as his choice for his particular bow, the width at any section is found by multiplying the width at " root" by the ratio of the two perpendicular distances from the string.

Procedure in Laying Out a Bow with Rectangular Limbs
Graphical Method as Developed by Dr. Paul E. Klopsteg

Tools: A flat surface, table top or floor space, large enough to develop a sketch for a full size bow. A piece of paper (wrapping paper is adequate) long enough to accommodate the length of bow selected. Scotch tape. A straight edge (this may be a board with one edge surfaced on a jointer or planer). A triangle or carpenter's square, steel tape or folding ruler. Bow pencil.

Materials: Bow Stave, 5′ to 5′6″, of any standard bow wood in the desired width and thickness: Hickory, Lemon Wood, Osage Orange, Lancewood, Yew.

In our experiment, lemon wood of the following dimensions was used and three *bows were constructed. No. 1 had a rectangular cross section of

*(These bow staves yielded 5′6″ bows, and for a 27″ arrow the pull was 18 to 22 pounds for No. 1; 33 to 38 for No. 2, and for No. 3, 48 to 55 pounds. Relating these "pulls" to the corresponding cross sections we have for this lot of lemon woods staves, a factor of approximately .2 square inches of cross sectional area per pound of pull. This data was not obtained from a sufficiently large number of test pieces to conclude that there is a precise figure to use when approximating the root cross section of a bow, but it should serve as a rough guide.)

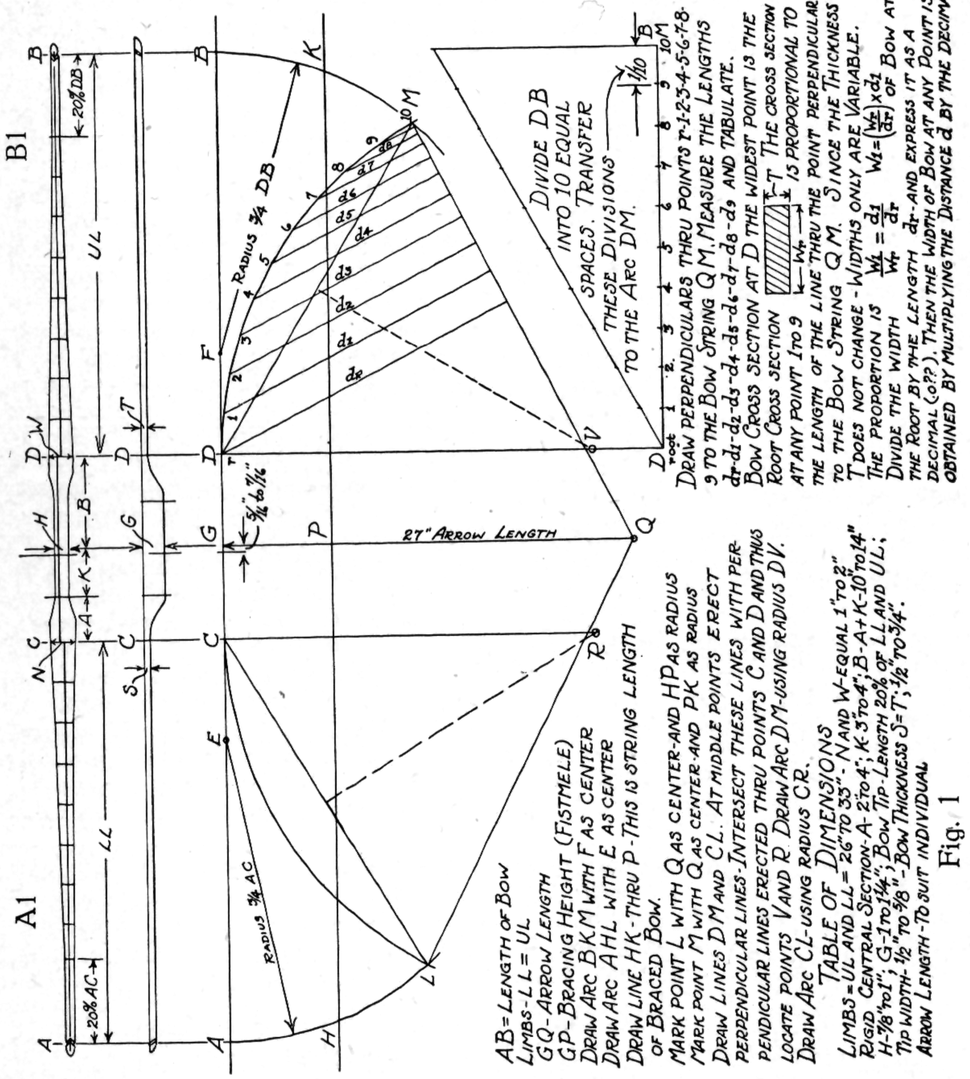


Fig. 1

7/16″x1″, which gave the "root" area of .4375 square inches; No. 2 a rectangular cross section of ½″x1¼″, which gave the root area of .625 square inches; No. 3 a rectangular cross section of ⅝″x1½″, which gave the root area of .9375 square inches.

Instruction:

1. Attach the paper to the flat surface with scotch tape. Along the top, about an inch from the edge, draw a line, with the straight edge parallel to the edge of the paper, the length of the bow. Mark this length A-B, as shown in Fig. 1. Mark the center point of the line A-B.

2. Draw a line at right angles to A-B, from point G, ⅜″ above center point as shown in Fig. 1, the length of the arrow (26-27″ or 28″ for a 5′-6″ bow), and mark the point Q. On line G-Q mark point P one "fistmele" (distance from back of bow to string), Fig. 2. This is approximately 7″ from line A-B, or rather, the center of the axis of the bow. This shows the position of the bow string on the braced bow. Through point P draw a line parallel to line A-B, Fig. 1.

3. Locate points C and D, which determine the length of the rigid central section. This length may range from 10″ to 14″ and is divided into three parts, A-K and B. Part A may vary between 2″ and 4″. K between 3″ and 4″ and B is A plus K. "Increasing the length of the rigid section is not detrimental, but rather beneficial." The handle or grip dimension G (1″ to 1¼″) and H (⅞″ to 1″) are unimportant and a matter of individual preference.

4. Make the thickness S and T, points C and D equal (½″ to ¾″) and draw the line parallel to A-B to each end of the bow. Make the length of each limb L-L lower, and U-L, upper, equal. Mark points A1 and B1, each 20% of the respective limbs.

5. Establish points E and F one fourth the length A-C and D-B. Scribe the *arc B-M with a radius F-B and arc A-L with radius E-A. Mark points K and H where these arcs cut the line through point P. This dimension is the length of the bow string when the bow is braced, with the nocks at points H and K. P-H is the lower and P-K the upper segment of the string.

6. Mark point L on the arc A-H, using Q as the center and the length P-H as a radius.

7. Draw lines perpendicular to A-B at points C and D, also draw the lines D-M and C-L. At the mid-position of D-M and C-L, erect perpendicular lines. Continue these lines until they intersect with the lines erected at points C and D. This defines points V and R. Through these points as centers and with V-D as a radius, draw the circular arc D-M, and the arc C-L with radius C-R from point R as the center. This is the arc the upper and lower limbs should follow when the bow is fully drawn.

8. Divide line D-B into ten equal parts as indicated. Transfer these dimensions to the arc D-M with a pair of dividers, or from marks made on a piece of paper. Lay off ten equal divisions as indicated and draw lines through each point from 1 to 10, perpendicular to the bow string, Q-M.

9. "The widths of the limb at each numbered point are proportional to the perpendicular distance between the point and the bow string" Measure and tabulate this length and find the ratio of each length to length. "Multiply the width chosen for D by each of the ratios in turn, which gives each width corresponding to the numbered points."

10. Lay off the tabulated widths on the back of the bow stave, on either side of the center line. Use a bow pencil or transfer by marks made on a piece of paper. Connect the end of each line, using a ruler, drawing lines as indicated in Fig. 3, Sketch D. Continue this on both sides of the center line until point 7 or 8 is reached. Theoretically, the cross section at point 10 is zero, but the width should not taper to a point where it is less than the thickness of the limb. Draw lines parallel to the center line, as shown near point B, Sketch D. The bow width or distance between these lines should correspond to the thickness of the limb. Extend these

*This is an approximation. The arc which the bow tip actually describes is a curve called the cardioid which closely approximates a circular arc made with a radius ¾ DB.

lines to points 7 or 8 and terminate them where they cut the width lines, transferred from the table of widths.

11. Lay out the handle according to individual preference. Here are a few suggestions which should improve the cast of an arrow.

a. See Sketch A, Fig. 2, which is a view of the front of the bow. Note that the center lines of both the upper and lower limbs are in alignment, also that the center line of the handle or grip is "displaced a 1/16" to 3/32" of an inch toward the arrow," shown resting on a shelf made by cutting a notch in the mid section, ⅜ of an inch above the center line of the bow.

b. Sketch B shows a side view of the rigid section of the bow and a gradual slope from the highest point in handle thickness to the thickness of the limb. The position of the pile resting on the shelf is also shown. In Sketch C, the view from the back of the bow shows the groove cut under the shelf to clear the lower feather. The grip may be made thicker on the side of the handle below the arrow shelf as indicated in Sketch D. This fullness tends to keep the thrust of the bow hand in line with the arrow.

The purpose of this offsetting the center line of the grip is to improve the shooting quality of the bow by bringing the bowstring and arrow more nearly into alignment, while the arrow passes by the bow.

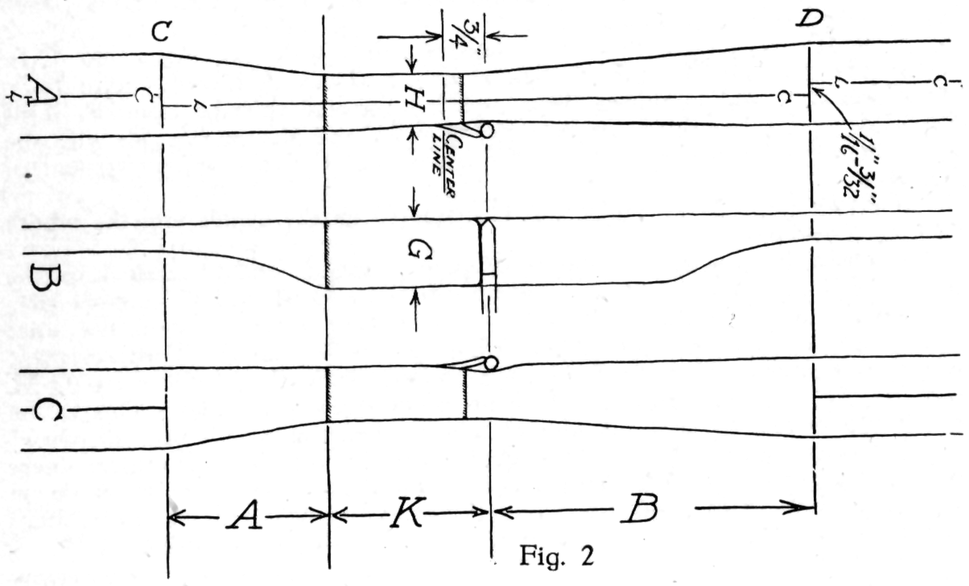
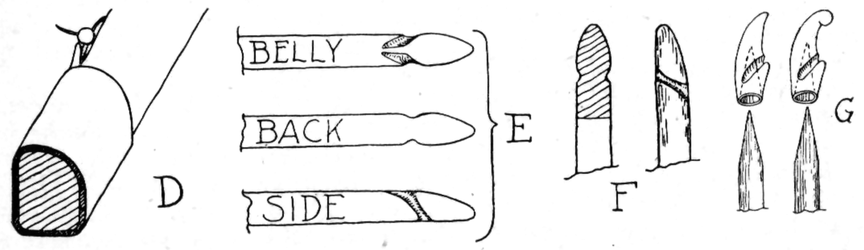


Fig. 2



Select a stave of a cross section that will yield a bow of the desired size. As a rough estimate to guide in the selection of a stave, the cross section width at the root of the limb, as shown for the three lemon wood bows, page 322, may be followed.

The Construction of the Graphically Designed Bow

Tools: Saw (a power band saw or a hand saw); Mallet and Flat Chisel, ½" to ¾". Try Square, Pencil, Steel Tape or Folding Rule. Small Block Plane No. 2 size, Spoke Shave, Scraper, Wood Rasp. 8". ⅛" Round Rat Tail File. Nos. 1½, 0, 000 Garnet Paper. Bow Pencil or Compass, Tillering Stick, Jig. Glue—Casein, Hoof Glue or Plastic (liquid).

Materials: Bow Stave—Hickory, Lemon Wood (Degame), Lancewood, Yew, Osage. Reinforcement strip of fiber or rawhide, ½"x2", or a backing of Hickory ⅛" to 3/16" thick.

Instruction:

1. Lay Out the Limbs

Transfer the data obtained by the graphical method for laying out the limbs to the bow stave.

a. Find the middle point of the bow stave and mark with a short pencil line to indicate its position. Select the upper and lower limbs and mark a line ¾" above the center mark on the upper limb. Carry this line around the bow stave with a try square.

b. Lay off the distances A-K and B, which locate the central section of the bow, Sketch D, Fig. 1. Carry these lines around the stave.

c. Select the front and back of the stave, and lay out the thickness.

1. If the bow stave is square, mark a line to indicate chosen thickness on each side of the stave, parallel to the back and extending from each end to the middle section, Sketch A, Fig. 3.

2. If the bow stave is flat, build up the middle section for the handle by gluing a piece of wood (the riser), to the belly side of the stave, as indicated in Sketch C, Fig. 3.

d. Draw a center line down the back of the bow stave from each end to points C and D, Sketch D.

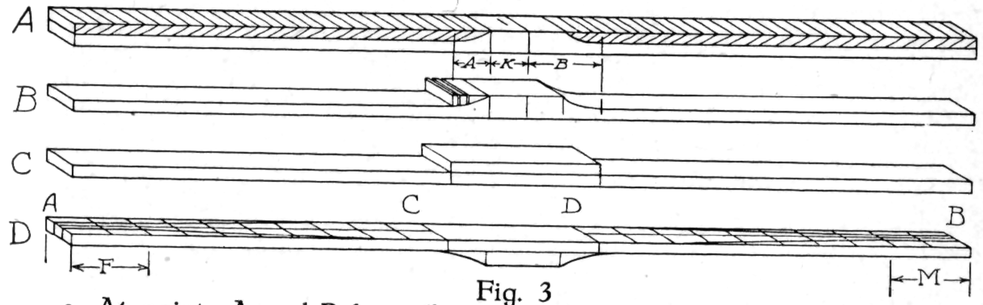


Fig. 3

e. At points A and B lay off a section equal in width to the thickness of the bow, for a distance F and M, Sketch D. These lengths are approximately 1/5 of A-C and D-B.

f. Mark lines 1 to 10 on the upper limb of the bow with the try square. Transfer the widths taken from the design sheet for lines 1 to 10 to the bow stave with a bow pencil or compass. Connect the ends of these lines from point to point with a straight line. Lay out the lower limb in the same manner.

2. Saw the two limbs to the tapered outline, removing the portion of the stave indicated by the shaded line, Sketch A. This may be done with a band saw, or with a hand saw, mallet and chisel.

3. Lay Out the Central Section of the Bow

a. Mark a guide line on the back of the bow, displaced 1/16" to 3-32" toward the arrow as indicated in Sketch A, Fig. 2. Use this as a center line and mark the dimension H (width of grip) ⅞" to 1" wide for the distance K (length of grip).

b. Draw the tapered lines from the bow grip, section K, to the points C and D, the widest section of each limb, Sketches A and C, Fig. 2. Allow a little extra width to permit the construction of the arrow shelf shown in Sketches B and C, Fig. 2.

4. Saw the central section to the guide lines.

5. Trim the stave down to approximate size and shape with a sharp spoke shave, followed with the wood rasp, then with coarse No. 1½ Garnet paper. Cut the arrow nocks with the rat tail file as indicated in Sketch E.

6. Reinforce the Tip of the Bow, from a point one inch below the nock, with a piece of fiber or rawhide glued to the back as shown in Sketch F, Fig. 2. If horn tips are to be applied, shape the ends of the bow stave as indicated in Sketch G.

7. Tiller the Bow (Process of developing uniformity of curvature)

Method A—Tillering Stick.

Place the paper on which the bow arcs have been developed on a flat surface (table top or floor). File a slight groove to locate the nock and attach a cord (an old bow string or heavy cord) at this point. Place the bow on the "tiller", Sketch A, Fig. 4, and draw the cord to the first notch. Place the tiller and bow over the design and compare curvature with the curves drawn on the paper.

Inspect the curvature. Test for uniformity of thickness with a gauge, Sketch B.

Sand the roughed out bow with the rough, medium and fine garnet paper, stretched over a block of wood, until the thickness gauge fits snugly at all points. Any stiffness of the bow limbs is apparent by the lack of conformity to the curve on the paper. Correct this by rasping, scraping and sanding the sides of the bow after each "tillering." Increase the tension on the bow by pulling the cord to a greater distance on the tillering stick, and compare the curvature with the drawing. Continue tillering until the bow conforms to the circular arc for the selected arrow length.

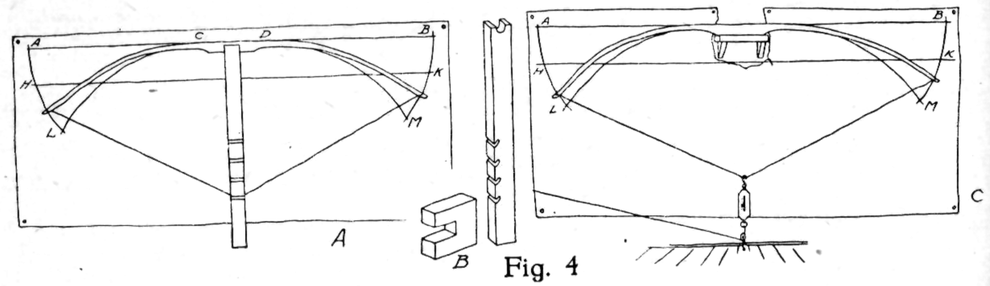


Fig. 4

Method B—Tillering Jig.

Place the bow graph sheet on a vertical surface—underneath a bracket or shelf attached to a wall or work bench. This supports the bow strung as in method A.

Attach a screw eye to the floor directly below the bracket on a center line as indicated in Sketch C, Fig. 4. Attach a small single sheave pully to the screw eye and pass a piece of woven sash cord through the pulley. Attach the rope to a spring scale which is hooked over the bow cord. A pull on the end of the sash cord draws the bow, and the scale indicates the pounds pull required to draw it to the proper curvature for the selected arrow length.

Test for uniformity of thickness and continue scraping and sanding the bow to the thickness and width required and until the proper curvature results from the desired pull.

It is a noteworthy fact that with the growing public interest in Archery more craftsmen are seeking materials to make their own bows, arrows and accessories.

8. The Bow Grip may be finished in several styles according to the preference of the archer. The basic construction is shown in Fig. 2, Page 324, Sketches A to D. The handle or bow grip length G and width H rectangular cross section may be shaped to give a comfortable hand hold. In Sketch D a cross section is shown in which the height directly below the arrow shelf is nearly the full dimension G.

The purpose in off-setting the center line of the grip is to improve the shooting quality of the bow, by bringing the bow string and arrow into alignment while the arrow is passing the bow.

In Sketch C the groove beneath the arrow shelf is shown. This is cut to permit the lower feather on the arrow to pass freely.

The bow handle may be covered with leather, skived thin at the edges and at the overlapped joint, and cemented in place. Sheet cork makes an excellent cover for the grip and cord wrapped closely around the handle is satisfactory. A woven leather thong knot (double length three bight knot, page 114, or the multiple thong knot, page 122), is ornamental and provides a hand hold which will not slip.

9. The question of backing a bow is debatable. Tests of straight bows, with and without backing (not reflexed), while not exhaustive enough to be conclusive, indicate that while the cast of the bow may be slightly increased, the efficiency may not necessarily be improved. The chief merit of backing, with fiber, rawhide or laminated wood, is the prevention of slivers rising out of the back. Another safeguard against slivers is a coating of shellac, varnish or lacquer built up by repeated applications.

10. Finish the Bow. Any standard wood finishing method may be employed after the bow has been adequately tillered.

a. Sand all over with the No. 000 garnet paper and apply a coat of shellac or sanding sealer.

The Bow String

11. The Bow String. Sinew (shredded tendons of animals), silk threads, and vegetable fibers were the bow string material used by Bowmen through the centuries in which Archery flourished. The best hand made bow strings used today are made of flax or linen. The standard has been Barbours Irish flax. During recent years a flax has been grown in Oregon, from which excellent thread and bow strings may be made.

The hand laid bow string may be made to fit any bow strength by the plying process, that is, by building a string made up of as many strands as may be required.

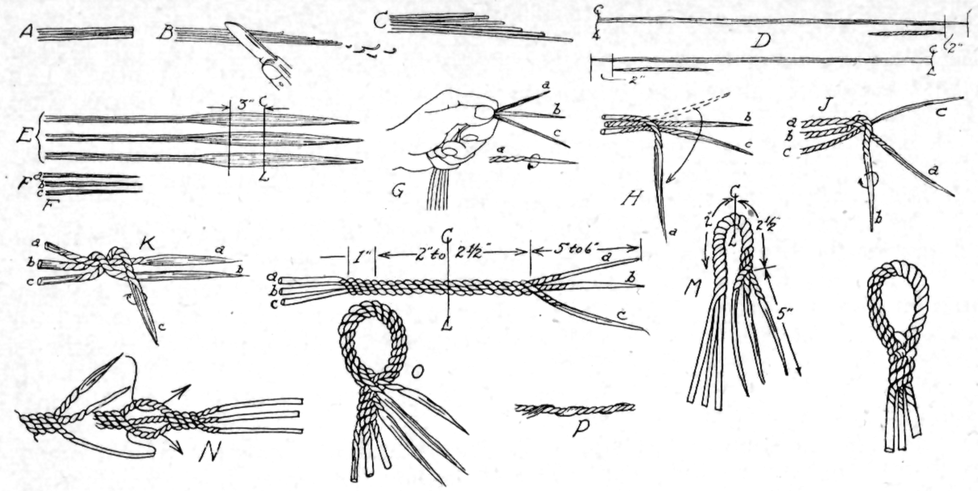
Two methods of assembling the strands are described. After the strands are assembled and the ends reenforced. the procedures of making the string is the same.

Method A

Select a place where two nails may be driven into the wall or edge of work bench, sixteen or eighteen inches longer than the bow length.

1. Tie the end of the thread to one nail and carry it over and around the other nail. Return to the first nail, go under and around it. Repeat this as many times as required, for the predetermined strength of the string. A rough approximation is 2 pounds of tensile strength per length of single ply size No. 12 Barbours flax (linen) shoe thread. The tendency in following a "rule of thumb" is to make the string too heavy. The string should be strong enough and have a margin for safety. Six, seven, eight or nine threads between nails will give the correct number per ply. This is to be a 3 ply string. Cut the loops around one nail and hold the strand together until it can be pulled across the wax a few times to hold the threads together. Two or three times over the wax for the entire length should be sufficient. Cut the loop at the other end. Make two more strands.

The Bow String



2. Space two nails about 12″ apart, and make six strands twelve inches long, containing four threads each. Wax as directed in step 1. These reenforcing lengths are to be waxed into each ply.

3. Scrape the ends of each ply with a dull knife as indicated in Fig. 4, Sketches A-B-C.

4. Place the short lengths of reenforcement on each ply about 2″ from each end and wax both together as indicated in Sketch D, Fig. 4.

5. Make a Three Strand Rope.

Sketch E shows the three plies, a-b-c, also CL, or the center line, through the reenforced or thickened end section of each ply.

About 3″ from the center line place the waxed ends side by side, see Sketch F. Hold the strands as shown in Sketch G. Twist strand (a) to the right and pull it forward over the strands (b) and (c) as indicated in Sketch H. Repeat this process for each strand in turn. Sketch J shows strand (b) twisted to the right and pulled forward across strands (e) and (a). Sketch K shows strand (c) twisted to the right and pulled forward across strands (a) and (b). Continue laying the strands into a rope for a length of 4 to 5 inches as indicated in Sketch L.

6. Make a loop (Eye Splice) in the end of the Bow String. Sketch M shows the strand with the end folded back along the center line. See dimensions indicated in Sketch L.

a. Open up the three strand rope by twisting the right hand clockwise until the strands are separated as shown in Sketch N.

b. Pass the two strand ends down through the opening indicated by arrows and pull the ends up to a tight junction, as indicated in Sketch O.

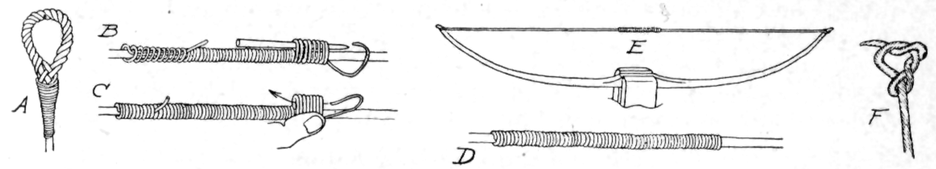
c. Flatten each end and wrap it around the rope strand underneath as indicated in Sketch P. Relay the three strands below the splice. (Follow procedure indicated in Sketches H, J & K), until the tapered ends are concealed.

7. Wax the String

a. Place the loop over a support about 6 feet above the floor. Apply wax to the loop and twist the tapered strand to the left between the hands. Stretch all three strands by pulling them taut and holding them together between the thumb and forefinger of the left hand about two feet from the loop.

Apply wax with the right hand and twist the strand to the left about eight complete turns.

Repeat the straightening, waxing and twisting process for the middle third of the string, about two feet. Continue this process for the rest of the bow string. Tie an overhand knot in the lower end to keep strands from fraying.



8. Place the string on the bow by slipping the loop over the end of the upper limb and permit it to slide down about six inches below the nocking point. Make the free end of the string fast to the nock in the lower limb with a "timber hitch" as shown in Sketch F. Brace the bow and slide the upper loop into the nock.

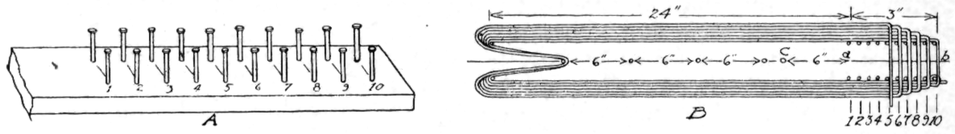
9. Serve the center of the Bow String, also the tapered splice below the loop, by wrapping it with thread. The end of the serving thread is tucked back under the last half dozen loops as indicated in Sketch A.

Place a pencil or other tapered point against the string and make the loop over both. Hold the thumb against the loop and remove pencil. Pass the end of the thread through all open loops, and pull taut. Coat the serving with shellac.

Method B—Assembly Jig

The device shown in Sketch A is made on a board 30″ long and 1½″ wide. This method of assembling strands or plies for the bow string has the merit of tapering the ends uniformly.

A single knife cut along the line A-B cuts all loops made around the nails shown in Sketch B. This makes a taper of about 3″.



ARROWS

"Straight as an Arrow" is the phrase often used to compare mechanical alignment or forthrightness. Besides being straight, arrows must meet a specification for **weight,** selection within a range of 10 grain variation; **balance** at a given point; have a specific quality which is a combination of resiliency and stiffness known as **spine.** After the foregoing specifications have been met a matched arrow is one which has been tested for performance in a shooting machine. At a given distance, matched arrows must fall within the boundaries of the test circle.

This exactitude, however; should not imply that the art of arrow making is formidable and therefore only for the master craftsman. The guiding principle of present day designers known as the Three F's—"form follows function," holds just as truly for the craftsman archer. Some research on the characteristics of arrows has been made, and it is to be hoped the findings when conclusive, will be made available for the "rule of thumb" methods yield to more scientific procedure.

Hard woods (dowels of birch) are suitable for the beginner, since these are available from Archery Supply sources and require very little work to produce an arrow shaft. Semi-finished shafts with the nock cut and "pile" or tip attached are available in standard arrow length. These require only to be "fletched" or feathered.

The arrow length is selected to suit the individual archer. The style and type is determined by their intended use, whether Target, Roving, Flight and Hunting arrows. The selection is made accordingly as to size and kind of shafts, type of arrowhead, shape of feather, form of nock. Birch dowels are rugged and although they have a tendency to warp may be sprung back into shape. Port Orford Cedar, Spruce, Norway Pine, because of straight grain are preferred arrow woods. They may be used for the entire shaft or "footed" with a reeinforcing tip of harder wood to give additional strength. An arrow made from only one wood is called a "self arrow."

Arrow Length Determination

There is a proper length arrow for each individual archer, conforming to his arm length and his chest measurement.

A method of measurement which the writer has found to yield an arrow length which conforms to both his shooting style and anatomical structure was obtained in the following manner. His style of shooting is to draw the bow string to the tip of chin.

Take the unstrung bow in hand. Place a "yard stick" or rule in the arrow position on the bow hand. Bring the bow hand into shooting position. Place the unsupported end of the rule on the sternum (tip of breast bone), lower the bow hand until the rule is horizontal. The distance from the sternum or center line of the chest to the back of the bow held vertically in this position is the **arrow length measurement.** When the rule is in a horizontal position the bow hand (with the bow held vertically) will be approximately midway between the arm pit and waist line.

Birch Arrow Making

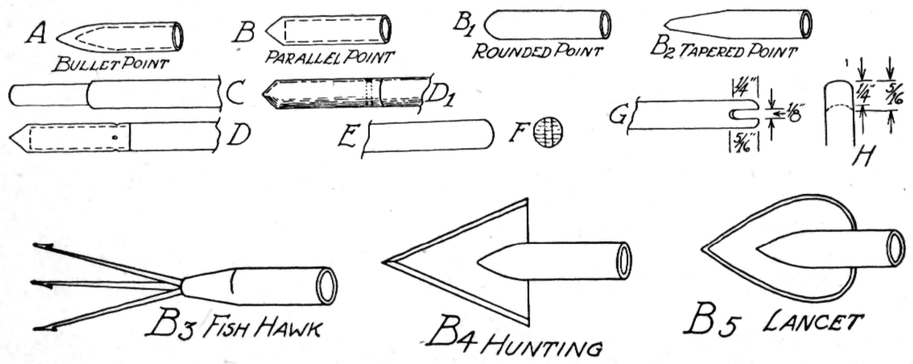
Select a dozen 5/16" dowels for straightness.

1. **Attach the point** (Parallel or bullet) see Sketches A and B.

(a) Measure the depth of cavity in the metal point and mark this dimension on the shaft, measuring from the end. Encircle the shaft with a pocket knife cut, to indicate the position of the shoulder, see Sketch C.

(b) Reduce the diameter of the shaft with a wood rasp until it fits snugly when driven into the point. If a lathe is available this operation may be done quickly and with precision. A satisfactory job may be done by hand.

(c) Drive the point onto the shouldered arrow shaft and secure it in position by two or three dents made with a center punch, see Sketch D. This operation may be done on a lathe with a knurling tool which makes a groove in the metal.



2. Cut the arrow shaft to the desired length and make the nock or groove for the bow string. Birch dowels may be nocked as indicated in Sketches F, G, H.

(a) Cut the nock across the grain with a saw about 1/8" wide and 1/4" deep. Three hack saw blades set in a saw frame approximate the correct width of nock.

(b) Round the bottom of the groove with a round taper file as indicated in Sketch G and H. This may be done with a piece of abrasive paper or cloth folded over a thin piece of wood or metal.

(c) Another method of nocking an arrow shaft is indicated in Sketch J and K. The shaft is shouldered as described for attaching the point and a tubular nock of fiber or molded plastic is driven on the shaft. The nock should be cemented in place.

3. Straighten the shaft by bending between the hands and sighting along the arrow for alignment. A shaft may be made more pliable by applying heat from a burner, however avoiding enough heat to scorch the work.

Port Orford Cedar and Pine Arrows

Arrow shafts made from these woods which are much softer than Birch dowels, have the merit of being much straighter and remain straight under hard use. Self arrows from either of these woods are made in the manner outlined for birch dowel arrows. The nock should be reenforced to guard against a tendency to split, which is characteristic of straight grained soft woods.

1. Cut a groove across the grain of the arrow shaft as indicated in Sketch L. Insert a piece of sheet plastic, Sketch M, which has been coated with the solvent or specific bonding liquid required for the plastic used. Celluloid requires acetone. Catlin requires liquid plastic. Apply pressure to the wood on each side of the inset. A clamp, vise, or a few turns of string, wrapped around the shaft may be used. Only sufficient pressure to insure contact is required. Duration of pressure—a five to ten minute period.

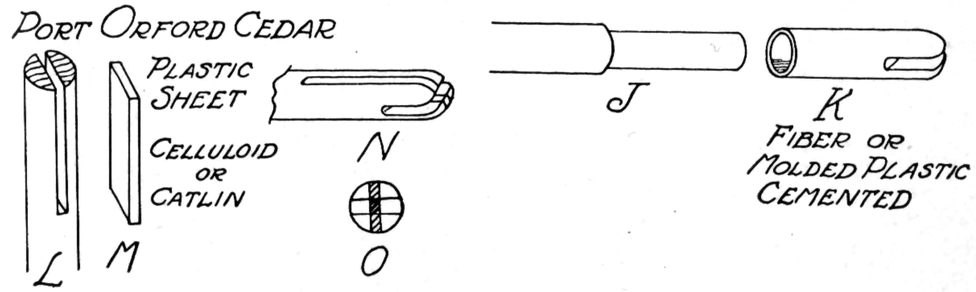
2. Cut the nock in the arrow shaft at right angles to the plastic reenforcement, see Sketch N and O. Follow procedure given under Step 2 (a) and (b) for birch arrows. See method of reenforcing the base of arrow, page 335, detailed for footed arrows.

Finish the Arrow Shaft

(a) Sand the arrow shaft with No. 000 Garnet Paper and apply a coat of shellac. Varnish or Lacquer.

Feather or Fletch the Arrow

Feathers are used to stabilize the flight of an arrow and keep the shaft moving point first. The famed Gray Goose provided the feathers used by archers when the demand for arrows sustained the Guilds of Bowyers and Fletchers. Goose and Turkey feathers are the chief source available for arrow making today.



Preparation of Feathers

Tradition dictates that arrows should be fletched in sets of three with identical sections taken from three feathers plucked from the same wing. Two methods of producing feathers are described.

1. **A Stripped Feather** is one in which the vane is torn or stripped from the quill with a downward pull as indicated in Sketch A. There should be no pith from the quill on a properly stripped feather. Feathers 10″ to 12″ long are preferable and each feather should yield a strip long enough to cut three pieces 2½″ to 3″ in length. The **tip, middle section,** and **butt,** are shown in Sketch B. Select these strips that are comparable for vein weight and cut them into the three sections indicated. Use the three **tip sections** on one arrow, the three **mid sections** on another, and the three **butts** on another. One of the feathers should be different in color from the other two, to identify the position of the arrow nock. This is called the cock feather. A section of the stripped feather is shown in Sketch C. The excess quill should be cut away as indicated in Sketch D, Fig. 1.

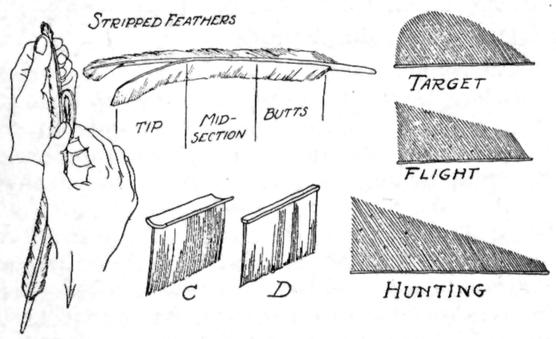


Fig. 1

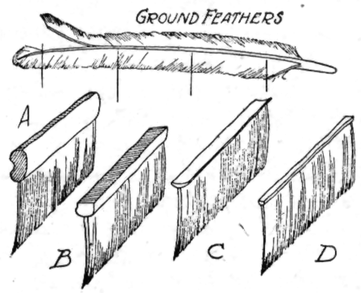
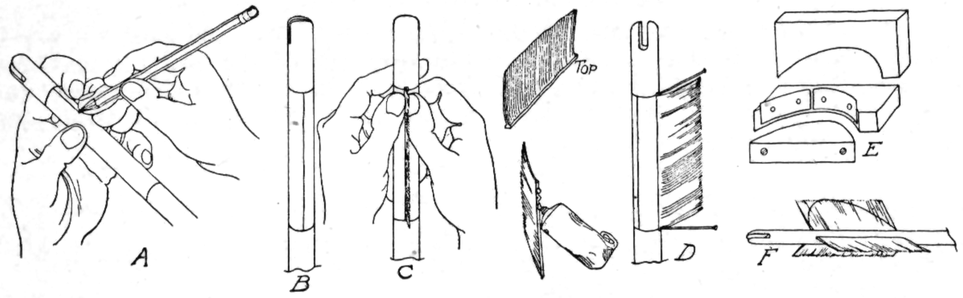


Fig. 2

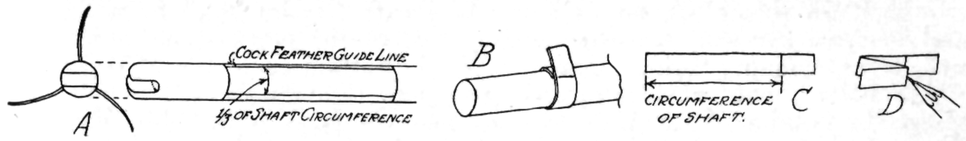
2. **A Ground Feather** is one which is made as shown in Fig. 2, Sketch A shows the feather with the narrow width vein partially removed by stripping. The feather is then cut into three sections by shearing across the quill. Sketch A shows a section of vane attached to the quill. A sheared length of the feather is held between two pieces of thin sheet metal and the quill is trimmed with a knife as shown in Sketch C, on abrasive cloth or paper. A motor driven sanding disc speeds up the work. The excess quill is trimmed off with a pair of shears and the feather ready to be used appears as indicated in Sketch D.



Hand Method

Mark a line on the arrow shaft at right angles to the nock as indicated in Sketch A. This is the position for the "Cock Feather." The other two feathers are spaced equidistant and at third points on the circumference of the shaft. The feather position may be approximated by guess work or determined by measurement. A strip of paper is useful in finding the correct feather position. Wrap the strip of paper around the arrow shaft and make a pencil mark where the paper band crosses the end of the strip as suggested by Sketch B. The distance between the end of the paper and the pencil mark, Sketch C, is the circumference of the shaft. Fold the paper into thirds as indicated in Sketch D. Crease the paper at the folds and mark their

position on the paper strip. Apply the strip of paper to the arrow shaft by placing the end of the strip on the cock feather guide line. Wrap it around the shaft and mark the position of the creased lines. Draw guide lines through these points with a pencil free hand, using the fingers to gauge the spacing as indicated in Sketch E.



Attach the Feathers to the Arrow Shaft

The arrow may be fletched without any special equipment. **Feathers stripped or ground,** a **tube of household cement,** and a few pins, shears, pencil and ruler are all that is needed to feather an arrow.

Apply the cement to the feathers from the tube and quickly place the cement coated cock feathers on the guide line with the top of the feather 1¼″ below the nock. see Sketch B. Hold the feather between the thumbs as indicated in Sketch C. As soon as the adhesive begins to set remove the thumbs and insert a pin in the upper end of the quill, as shown in Sketch D.

Move the thumbs along the vane exerting pressure on the quill while preserving the alignment with the pencil mark. The vane of the feather should cover the pencil mark. After a good contact is secured between the quill and the shaft insert another pin in the lower end of the quill, as indicated in Sketch D. Repeat the process for each of the other feathers. Permit the arrow to remain undisturbed until the glue sets. Shape the feathers by methods described.

The stripped or ground feathers may curl and warp out of shape.

When this occurs they are too dry and should be softened by wrapping them in a moist cloth until they become pliable. Any vane separation should be restored by contacting separated edges and smoothing out with the fingers.

Trim Feather to Shape

1. This may be done with a pair of sharp shears and a metal template or pattern.

2. Another method of cutting the feather to size and shape is to make a cutter. One type of cutter may be made by attaching razor blades to a block of wood shaped to correspond to the feather outline. This type of cutter and its use is indicated in Sketches E, page 332. The untrimmed feather is placed in contact with the edge of a soft pine board, and the cutter is set upon the feather and pressure applied by hand.

3. Some fletchers shape a nickle chromium resistance wire to conform to the outline of the feather style and pass current through it which heats it to incandescence. The arrow shaft is revolved and the feather vanes are brought into contact with the hot wire, and are thus shaped by the contour of the wire. This method of shaping feathers has much to recommend it. No ragged edges are left on the feather shaped by the hot wire method. However, good ventilation is desirable in the room where this method is used.

Construction of a Fletching Jig

The use of the simply constructed jig for holding the arrow while attaching the feather will save time, and insure uniform results. The details for making the jig are shown in page 334, Sketches A to E.

Materials: 2 pieces of pine 2″x18″x¼″; 1 piece 2″x4″x1⅛″ to 1½″ thick and 1 piece 2″x4″x¾″ thick.

1. Drill a 5/16″ hole in the 1⅛″ to 1½″ block; ¾″ deep. Locate the center of this hole ½″ from the top and 2″ from the end, see Sketch A.

2. On a center line one inch from the end of the block, Sketch B, lay out a circle and inscribe a hexagon as shown in Sketch C. Divide the circle into three parts by drawing the radius from the center of the circle to the corners of the hexagon as shown. At the center of the circle drill a 5/16" hole 1½" deep.

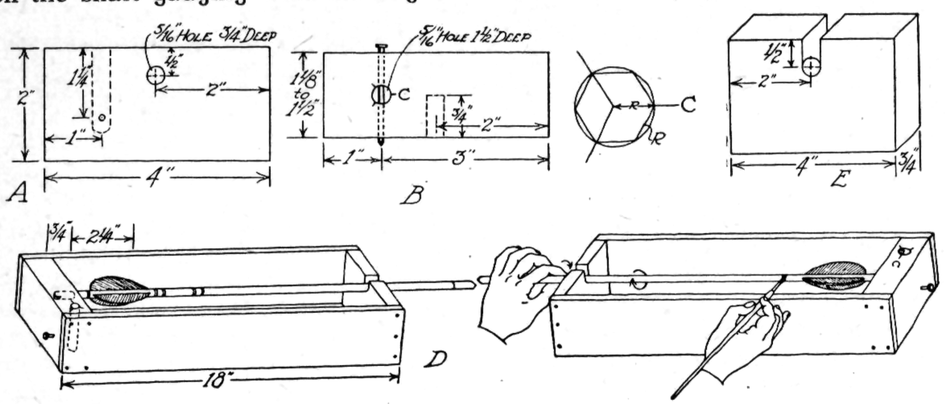
3. Turn this block on its side and locate a point 1¼" from the top and 1" from the end. On the opposite side of the block locate a point in the corresponding position. Drill a 3/32" hole from each side of the block. These holes should be in alignment and pass through the 5/16" hole, ¼" above the bottom. Through these holes pass a nail as indicated in Sketch B.

4. Into the 2"x4"x¾" block drill a 5/16" hole, 2" from the end and ½" from the top as indicated in Sketch E. Form a notch by cutting out the wood between the edge and the hole with a saw.

5. Assemble the jig as shown in Sketch D by nailing the two 18" pieces to the ends of the 2"x4" blocks.

Use of Jig

Place the nocked arrow in the hole drilled in the end block with the nock resting on the nail. This corresponds to the position of the arrow on the bow string. Mark the location of the three feather positions on the arrow shaft which correspond to the radial lines on the block. The center line of the block indicates the position of the cock feather. Remove the arrow and set it in the position shown in Sketch D with the nock inserted in the ¾" depth hole. Rotate the arrow shaft in this position by hand against a pencil point and scribe circles to show position of upper and lower ends of feathers. Scribe the guidelines to locate spacing of feathers on the shaft gauging with the fingers as described on page 332.



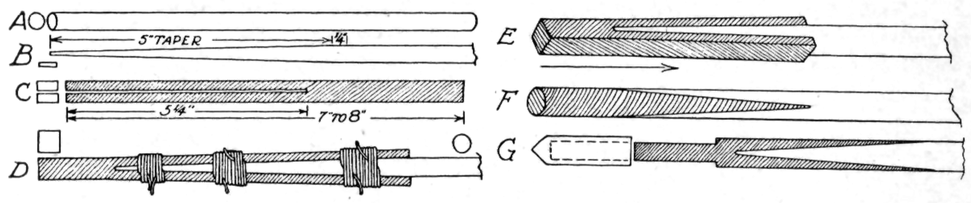
Follow fletching instructions given on page 332. Rotate the arrow shaft and attach the other two feathers in their correct position. The vane should cover the guide line marked on the shaft. Place the fletched arrow in a rock (a hole drilled into a board) to keep it upright until the cement or glue sets.

The Footed Arrow

The use of Port Orford Cedar-Norway Pine, because it is straight grained for arrow making has been mentioned. An arrow shaft made of these soft woods requires supplementary strength. Nock reenforcement to safeguard against splitting is desirable. Also the tip of an arrow should be strengthened to withstand the shock of impact with the ground or other hard object. Hardwoods are used to reenforce the points of weakness at each end of the shaft. Beef wood, Purple Heart, Lemonwood, and Lancewood make excellent footings.

Method of Footing an Arrow

1. The footing should be in the square ⅜"x⅜" and 7" to 8" long. The shafts may be round, 5/16" in diameter (⅜" for Hunting Arrows), or in the square ⅜"x⅜". The footing piece if not procured slit or saw cut on a center line should be cut to a depth of 5¼" from one end as indicated in Sketch C. The arrow shaft is tapered from the shaft diameter to the width of saw cut in a 5" length. See Sketch B.



2. Coat the tapered surface with adhesive (hot glue), casein, or liquid plastic, and drive it into the slot in the footing, as indicated in Sketch E. The footing and shaft should be held in contact by twine wrappings as indicated in Sketch D until the glue sets, preferably over night. Remove the twine and plane the footing into cylindrical shape in the direction indicated by the arrow shown in Sketch E. Finish shaping the foot with abrasive paper or cloth.

3. Shoulder the tip to receive the pile (parallel point) and secure with a small brad inserted in a hole drilled through the pile. Rivet the ends of the brad with a ball pein hammer and smooth with abrasive paper.

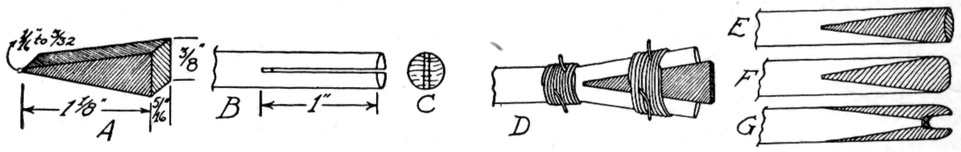
Reenforce the Nock

Matching or contrasting hardwood. horn, fiber, plastic, may be used to reenforce the nock.

1. Cut wedges of the material selected which taper from a ⅜" square top to a thickness of the saw blade 1/16" to 3/32" in width in a tapered length of 1⅛".

2. Cut a slot across the grain of the arrow shaft, see Sketch G, one inch in depth as indicated in Sketch B. Wrap a few turns of twine below the saw cut as indicated in Sketch D. Coat the slot and sides of the wedge with the adhesive and drive the wedge into the saw cut. Apply a twine wrapping around the shaft to hold the wedge and saw cut in contact as indicated in Sketch D. As soon as the glue sets (over night) remove twine and shape the end of the shaft to the shaft diameter with plane rasp and abrasive paper or cloth, see Sketch F. Round the end of the inset wedge, see Sketch F, and cut the nock as shown in Sketch G.

3. Finish and fletch as directed in steps outlined on page 331.



ARCHERY EQUIPMENT

Archery as a medium for the pursuit of happiness has much to offer, especially when it is established upon and sustained by the craftsmanship of the devotee.

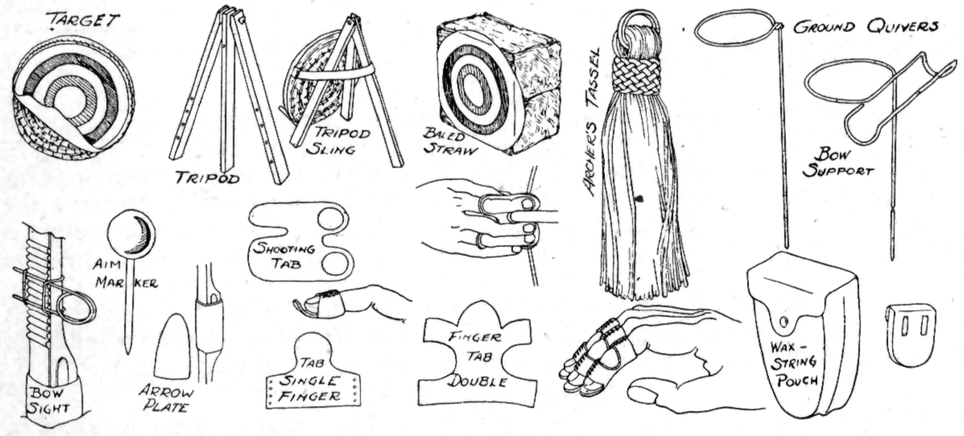
Besides Bows and Arrows, the essential "tackle," much handicraft may be employed in the construction of other equipment, the convenience and serviceability of which may be discovered as needs arise and refinements are sought

Accessories

Coiled straw mats 4″ thick, wound into a tight spiral and sewed with a sacking needle and twine (50″ in diameter), is the standard target.

A coiled corrugated paper (single faced) pad 5″ thick, assembled with flexible cement and wound with twine, also makes a serviceable target. Baled straw mounted on a support makes an inexpensive base for a cloth target face.

Arm Guards, Shooting Glove, and Quivers construction details are shown on page 89. Horn Bow Tips and Archers Tassel are detailed on pages 444-449.



An archer's appreciation for the response of his favorite bow and set of arrows is akin to the respect the violin virtuoso has for his Stradivarius. As interest in the sport of archery grows, coveted skills are caught, the improvement in one's performance on the Range comes through shared experiences.

Much has been written concerning the care and use of archery tackle. The references selected contain information valuable for the beginner and excellent reading material for the experienced archer.

Technique or School of Shooting

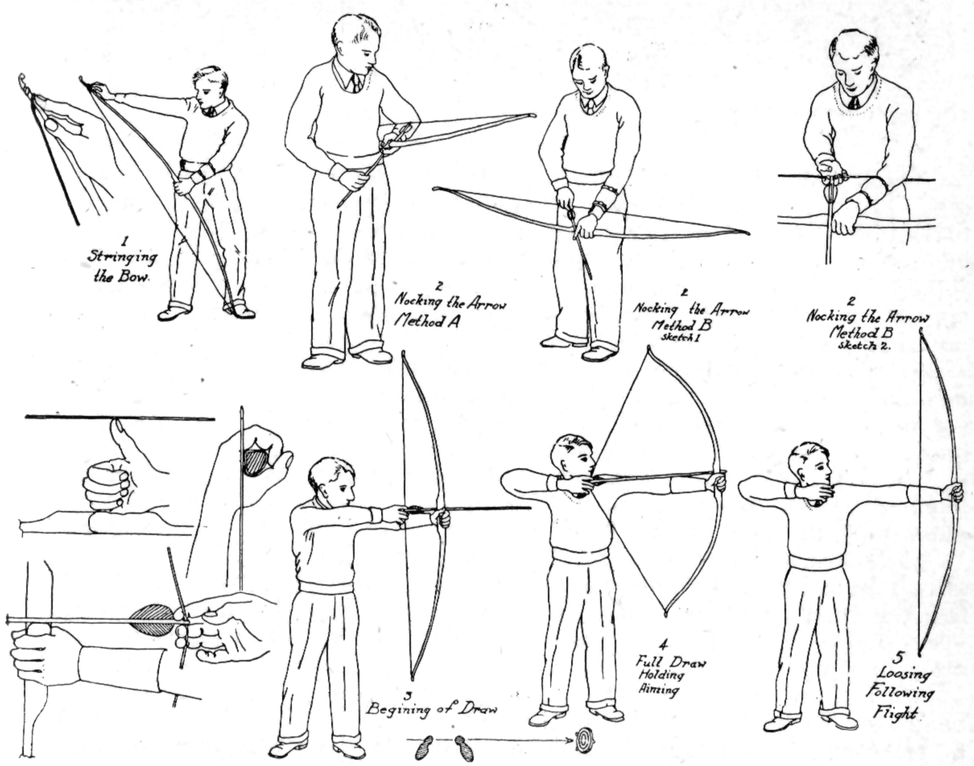
Called "Toxophilus or the Schole of Shoteing" by Roger Ascham, 1542.

1. **Brace the Relaxed Bow.** Place the lower bow tip against the instep of the foot, as shown in Sketch 1, Fig. 10. Extend the arm and place the heel of the hand against the upper limb of the bow about a hand length below the bow tip of the upper limb. Grasp the bow and grip and pull it toward the body. Slip the bow string loop into the nock or groove with the tip of the fingers, as indicated in the enlarged detail, Sketch 1. The distance between the bow string and the back of the bow grip should be approximately 6″. A rough guide is the "fistmele" which is the over-all length of one's fist with the thumb extended, see illustrative sketch, Fig. 10.

2. **Nock the Arrow.** Place the arrow on the bow string with the "cock feather up." This may be done by several methods, two of which are suggested in the three illustrations shown in Sketch 2, Fig. 10.

The important thing is to place the arrow in the proper position on the bow string. To insure this the serving may be wound back and forth over itself to enlarge the Bow string diameter, until it fits the arrow nock. The correct position must be determined for each bow. Many bows use ¾″ to

1″ above the center line of the bow length, for the arrow position. In the bow specifications developed on page 322 this distance is ⅜″ above the center line.



3. **Draw the Bow.** Since we are target shooting, we are standing astride of the shooting line with our bow arm extended. We are facing along the shooting line at right angles to the target. The fingertips we assume are covered with a shooting tab, finger stalls or a shooting glove, and that the forearm of the bow arm is protected by some type of arm guard. Place the arrow against the bow string, properly nocked, with the index finger of the drawing hand above the arrow tip and two fingers below, as indicated in the illustration shown in Fig. 10.

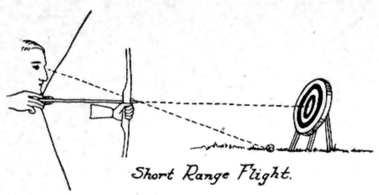
a. **Grasp the Bow Loosely.** The bow hand and relative position of the bow in cross section is indicated by the illustration, Fig. 10. The pressure against the palm of the hand should be distributed along a line extending from the heel of the palm to a point between the thumb and forefinger.

b. Distribute the body weight equally between the feet spaced at a comfortable distance apart. Stand erect and with the body relaxed, turn the head toward the target. Maintain this position as indicated in Sketches 3-4-5 of Fig. 10, during the drawing, aiming, loosing, and while following the flight of the arrow.

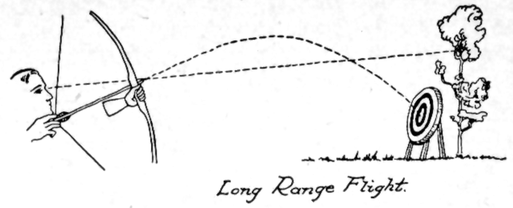
4. **Hold the Bow at Full Draw until the Aim is Established.**

a. Draw the arrow nock to the chin. The exact point on the chin is directly under the sighting eye. The correct position of this reference point on the chin is one **half the distance** between the pupils of the eyes, measured to the right or left of a center line through the nose and chin. The thumb of the drawing hand may be placed under and pressed lightly against the jaw bone. This contact locates the bow hand position at full draw.

A line from the point on the chin to the vertical center line of the target should pass through the axis of the arrow. The **line of sight, the arrow axis,** and **vertical centerline of the target** should all be in one plane.



Short Range Flight.



Long Range Flight.

The path of the arrow in flight, trajectory as it is called is a curved one. The shape of this curve is a variable which changes with the strength of the bow. Since the line of sight does not parallel the axis of the arrow but makes an angle with it a **point of aim** must be established. Its location should be somewhere on the vertical center line through the target and it may be found between the archer and the target for short range flights as indicated in Fig. 11, or above the target as shown in the sketch depicting arrow trajectory and the line of sight for a long range flight. It should be mentioned that at some intermediate distances, the point of aim falls on the target. A white ball 1½" in diameter or a 1" wide stick 3 or 4 inches long, make excellent point of aim markers.

b. Sight over the arrow pile, when the arrow and line of sight are in alignment, and move the bow hand up or down in the vertical **shooting plane** until the point of aim marker is just visible over the sighted pile.

5. **Loose the Arrow** by straightening the *three fingers which hold the drawn bow string without moving them from their position at the chin. In fact the thumb position under the jaw bone, although the contact pressure is very slight, serves to maintain the hand in its proper position during and after loosing the arrow.

6. **Follow Through** after loosing the arrow. This means that both hands are to be kept in the same relative position after the string is **loosed** or released. It is important that no change in hand position occurs while the arrow is passing the bow. Any movement of either hand during this fraction of a second destroys the alignment established during the process of taking aim.

The Target and Scoring

The standard archery target is four feet in diameter. Five concentric circles enclose the colors **White, Black, Blue, Red** and **Gold.** Numerical values are assigned to these colors which are proportional to the area each band of color includes within its boundaries. The outside diameter of 48 inches is divided into five parts. The Gold or central area is **one fifth** the outside diameter or 9.6 inches in diameter. The outer boundary of the red band is **two fifths** of the outside diameter or 19.2 inches in diameter. The outer boundary of the blue band is **three fifths** the outside diameter or 28.8 inches in diameter. The Black is **four fifths** the outside diameter or 38.4 inches. The rest is white and is bounded by the circle forty-eight inches in diameter. The radius of the Gold is 4.8 inches, which measurement is also the width of each color band and one tenth of the outside diameter. Since the area of each color circle is proportional to the square of its diameter, we find a total target area (five units in diameter) proportional to the figure 25.

*The three finger release is sometimes called the Mediterranean release. This release employs sufficient finger strength to permit drawing heavy bows where much shooting is done, as in tournaments. Although one finger above and two below the arrow precludes a symmetrical release at the center of the bow string. In the Asiatic, also called Mongolian release, the bow string rests on the thumb pad between the first joint and the end, while additional strength is contributed by pressure of the forefinger which is hooked over the thumb tip. This release was used by Ishi the Yani Indian—the last primitive American Indian whose life is described in the book "Hunting with the Bow and Arrow," by Dr. Saxton Pope. This release, somewhat modified, was used by the Turkish archers who protected the thumb with a ring of Horn containing a groove from which the bow string slipped during release without friction against the thumb.

The area of the Black band, **four units**, is proportional to the diameter squared, or the figure 16. Since the black area is included in the white area the actual amount of space included in the white band is 9 units, which remains after subtracting 16 from 25. In a similar manner we find each color band to contain its percentage of total area—White 9 units; Black 7 units— Blue 5 units; Red 3 units; Gold 1 unit. These figures taken in the reverse order give a scale for the measurement of shooting skill. The value based on the areas in each color for hits in the bull's eye or **Gold is 9 points; Red 7 points; Blue 5 points; Black 3 points; White 1 point.**

Scoring. Six arrows shot constitute an end. After each archer shoots six arrows the group walks to the target to score the hits.

a. **List the Highest Score First.** List the record of each arrow on the *score card. An arrow hitting two colors counts as hitting the inner one. An arrow passing through the target or rebounding from it counts as a hit with a score of five points. An arrow hitting the petticoat does not count as a hit or score.

b. **Keep a Record of Arrow Performance** by calling the position it occupies in the target, using both the color and a clock face reference. An arrow in the top of the White is designated as a "12 o'clock White." An arrow in the bottom, the Blue, is a "6 o'clock Blue," etc.

c. **Draw the Arrows from the Target with Care** to avoid injury to the feathers and possible bending of the shaft. Place the back of one hand against the target face with one finger above and another below the arrow. Press against the target with the back of this hand while pulling the arrow with the other. Arrows which penetrate the target beyond the lower part of the feather should be pulled through the target. An arrow pile embedded in the tripod support may require removal with a pair of pliers to avoid injury to the shaft or pile.

Range Finding

Before removing the point of aim marker for a given range make a record of the position on a stick (dowel 6" in length.) The method is to hold the dowel in the bow hand in the shooting position with the top of the dowel in the line of sight with the center of the target. Hold the dowel in this position (it may help to steady the hand to place it on the upper bow tip when the lower tip rests on the ground), sight at the point of aim marker and mark the dowel where the line of sight crosses it and indicate on the dowel the range for which the mark is made. This range finding gauge stick will save time in locating the position of the marker when any particular range is specified in a tournament.

STANDARD COMPETITION FOR TOURNAMENTS
INDIVIDUAL

Men

American Round

30 arrows at---- 60 yards
30 arrows at---- 50 yards
30 arrows at---- 40 yards

The York Round

72 arrows at----100 yards
48 arrows at---- 80 yards
24 arrows at---- 60 yards

Metropolitan Round

30 arrows at----100 yards
30 arrows at---- 80 yards
30 arrows at---- 60 yards
30 arrows at---- 50 yards
30 arrows at---- 40 yards

Women

The Columbia Round

24 arrows at---- 50 yards
24 arrows at---- 40 yards
24 arrows at---- 30 yards

The National Round

48 arrows at---- 60 yards
24 arrows at---- 50 yards

Metropolitan Round

30 arrows at---- 60 yards
30 arrows at---- 50 yards
30 arrows at---- 40 yards
30 arrows at---- 30 yards

American Round

Same as for men.

Juniors

Junior Columbia

24 arrows at---- 40 yards
24 arrows at---- 30 yards
24 arrows at---- 20 yards

Junior American

30 arrows at---- 50 yards
30 arrows at---- 40 yards
30 arrows at---- 30 yards

Junior Metropolitan

30 arrows at---- 40 yards
30 arrows at---- 30 yards
30 arrows at---- 20 yards

Number of Arrows	Hits	Score
997531--------	6	34
973550--------	5	29
Total------	11	63

*Typical Form of Score Card is shown here.

TEAM COMPETITION—FOUR MEMBER TEAM—TEAM ROUND

Women—96 arrows at 50 yards **Men**—96 arrows at 60 yards

One of the most prized N. A. A. awards is the "Six-Golds" Emblem which is given to any archer when he secures membership in the "Six-Golds" Club, by making his first perfect end at a registered "Six-Golds" Tournament.

Clout Shooting

Long range shooting at a 48 foot target laid out on the ground. A flag marks the center of the target. This is excellent practice in learning to judge distances.

Women—36 arrows at either 120 or 140 yards **Men**—36 arrows at 180 yards--

Novelty Events

The Wand Shoot—The target is a wooden slat 2 inches wide and 6 feet high. A 2" strip of cloth stretched over the regulation target may be used for this event.

Women—36 arrows at 60 yards **Men**—36 arrows at 100 yards

The Balloon Shoot—These may be tethered or free.

Silhouettes—Cardboard animals with central vital spots marked with a circle.

William Tell Shoot—Cardboard figure of boy with an apple or balloon tied to his head.

This may be single arrow or six arrow competition.

Flight Shooting—This is a test of the cast of a bow.

Games

Archery Golf—Use flight type bow and three arrows: a flight arrow; an approach arrow; and a target arrow for putting, on a regulation golf course. Target—4" excelsior ball covered with red yarn, placed two feet to the right of the cup. Set the ball on a 2" loop of wire, 2" off the ground. The game is played by—

1. **Make a long flight shot** from the regular tee.
2. **Change to an approach arrow** or target arrow. The problem of approach is to know how far and how hard to shoot and make the arrow stick.
3. **Shoot Out.** Either pierce the ball or knock it off the support. This is an excellent game for sociability. As a family game it is less intensive than target shooting.

Rovers is an ancient archery game. A Rover is any kind of a **standing mark,** post, tree, shrub, etc., designated as the mark "to be shot at" with one or two arrows, from a specified distance. A score of one point goes to the archer whose arrow is cast nearest to the mark. The traditional winning score is seven points.

ARCHERY ASSOCIATIONS

Archery Clubs in America are increasing in both number and membership. The years 1870-1895, mark a period of interest and development under the inspiration of Will and Maurice Thompson. A lull followed but again in 1912 interest in Archery was renewed and continues to be sustained.

The interest in local groups of archers became regional, through competitions, and the need arose to unify this activity on a national basis.

The National Archery Association

The National Archery Association, by virtue of its priority of establishment, its honorable and continuous record of achievement, the universal consent of archers, and by its constitution, became the supreme governing body in all matters that pertain to archery in the United States. Affiliation of clubs with and individual memberships in the N. A. A. may be had for a small annual fee.

The National Field Archery Association

Field Archery, a comparatively new activity in this country, is definitely rooted in many communities. It is a hopeful sign when groups of archers plan a program for the improvement and development of special skills and abilities among members of their association. Field Archery competitions for individuals and teams, include shooting at targets of different sizes, shapes, and from various distances. The N. F. A. A. encourages the use of both "the point of aim" and "instinctive" methods of shooting at stationary and moving targets.

Field Archery was included in the Sixty-first Annual Tournament of the National Archery Association, held in Portland, Oregon, August 4-9, 1941. Two Rounds—the California Field Round—**4 arrows at each of 28 targets at various distances**; and the Oregon Pope-Young Round, **1 arrow at each of 36 animal targets at various unknown distances;** were used. The program of this association is definitely worthwhile, since it develops awareness, alertness, judgment, and appreciation for the skill of others. All these are desirable qualities for any individual to possess, whether or not these special skills are sought for use in hunting with the bow and arrow. The service of archery as a definite factor in the development of America's youth, should be extended by including more "skill basis" events in the individual competitions.

Camp Archery Association

F. D. Stern, Secretary, 152 East 22nd Street, New York

Competition for both Girls and Boys

Juniors	**Seniors**
12 years and under	16 years and under
30 arrows at.....20 yards	30 arrows at.....30 yards
30 arrows at.....30 yards	30 arrows at.....40 yards

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Wood

There is a certain satisfaction and lasting enjoyment in the possession of an article in wood which has been enriched by cut designs. Plain surfaces except for color variations due to grain marking are dull and uninteresting. Glossy surfaces appear flat or glaring as the incident light is absorbed or reflected. Such surfaces are uninviting, and repellent, seeming to hold you off at arms length lest your presence mar and your touch despoil. Not so with the surface containing an incised area. However elemental in design or meager in extent there is a something that not only arrests your attention but intrigues you with enduring and increasing charm. The interplay of high lights and shadows among grooved, beveled and rounded surfaces alone is stimulating and inspiring, yet many of the faceted areas follow simple geometric patterns which may be cut with a single chisel.

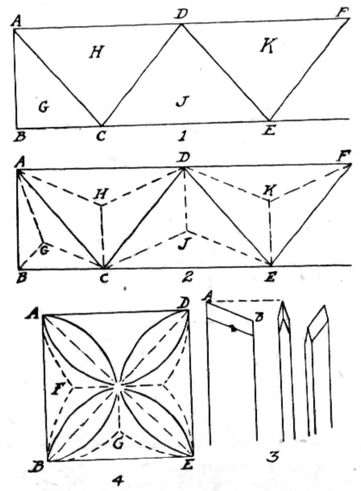
Examples of a few simple carved motifs are shown in Fig. 5. These were cut with a single tool known as a skew chisel. They may be used in borders, central patterns and all over designs. Nos. 1 and 6 are produced by cuts made along straight lines, while in the other designs the cuts follow curved lines. The method of laying out the guide lines for a carved detail follows.

GUIDE LINE LAYOUT FOR CARVED DETAIL

1. Determine the size and position of the area to be carved. The layout of the design No. 1, Fig. 1 is shown in the Sketches 1 and 2. Line A-B is the design width. Lines AC-CD-DE-EF are drawn as indicated in Sketch 1. The distances AD-DF and CE are equal in length. Pleasing proportions result when this dimension is made of any desired length, ranging between 1½ times to 3 times the width of the design AB.

2. Bisect each angle of the triangles ABC-ACD-CDE, etc., as indicated in Sketch 2 and draw the guide lines whose intersections are shown at points G-H-J. It is not necessary to bisect these angles by a geometric method. A line sketched free hand in the approximate position is sufficient.

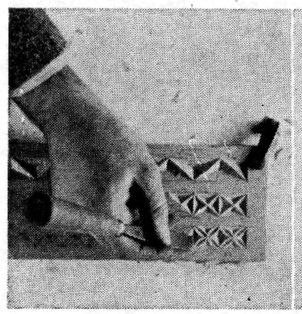
Fig. 1



WOOD
CARVING PROCEDURE

The equipment needed for carving the geometric designs shown in Fig. 1 and Fig. 3 consists of a skew chisel, mallet and a screw clamp or other means of holding the board. The skew chisel is shaped as shown in Sketch 3, Fig. 1. A is the point or tip. B is the heel. It will be noticed that the cutting edge of the chisel is in the center of the blade which makes it possible to use it for both right and left hand cutting strokes.

Fig. 2



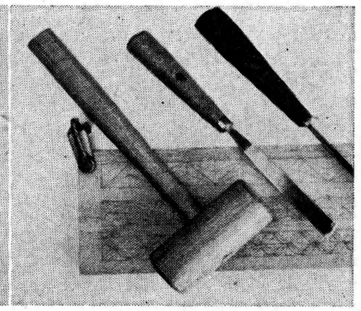


Fig. 3

Stabbing the Design. The stabbing is done on the guide lines which bisect the angles and appear dotted in sketch 2. Place the heel of the skew chisel on the point where the bisecting lines meet. See points G-H-J, Sketch 2, and rock it along each guide line, meanwhile exerting pressure with the hand. After a mark is made the length of the chisel blade, the process is repeated by placing the heel of the chisel on the guide line at the end of the first cut and rocking it forward to the point. Deepen the cut in the guide line by striking the chisel with the mallet. During the stabbing operation the chisel is kept perpendicular to the surface of the wood.

Removing the Chip. A pyramid shaped piece of wood is to be removed by chipping out bit by bit. The rocker motion of the chisel, described in the preceding paragraph, is employed in removing the pyramid. The base of the pyramid is uppermost and bounded by the triangle ABC, Sketch 2, Fig. 1 Point G is the apex.

The sides of the pyramid are the planes bounded by the guide lines shown in Sketch 2. The initial cut is to be made along line AC, beginning at C. Refer now to Fig. 4, No. 2 which shows the heel of the skew chisel in position to make the cut. Section 2 shows the chisel rocked forward, No. 4 shows the loosened chip ready to be lifted out and No. 5 shows the appearance of the cavity when cuts have been made along two sides of the triangle. No. 6 shows the cavity rough cut. It will be noted that in this operation the chisel must be held at an angle corresponding to the shape of each side of the pyramid, whereas in the stabbing operation the chisel is perpendicular to the wood.

Additional wood must be removed to make the cavity clear cut, and the process is repeated. No. 7 shows the stabbing of the guide lines which define the edges and apex of the pyramid. No. 8 shows the position of the chisel near the bottom of the cavity prior to the removal of a thin shaving which is shown in No. 9. In this final cut the heel of the chisel is placed in the stabbed guide line and when the cut has been completed the point of the chisel comes to rest near the apex of the pyramid and in the same guide line. No. 10 shows the cavity completed. Nos. 10, 11 and 12 show the same operation on an adjoining cavity. No. 10 shows the cavity after the first rough cut. No. 11 the completion of the second stabbing, No. 12 the clean-up operation which makes the cavity resemble the impression of a sharp pointed pyramid.

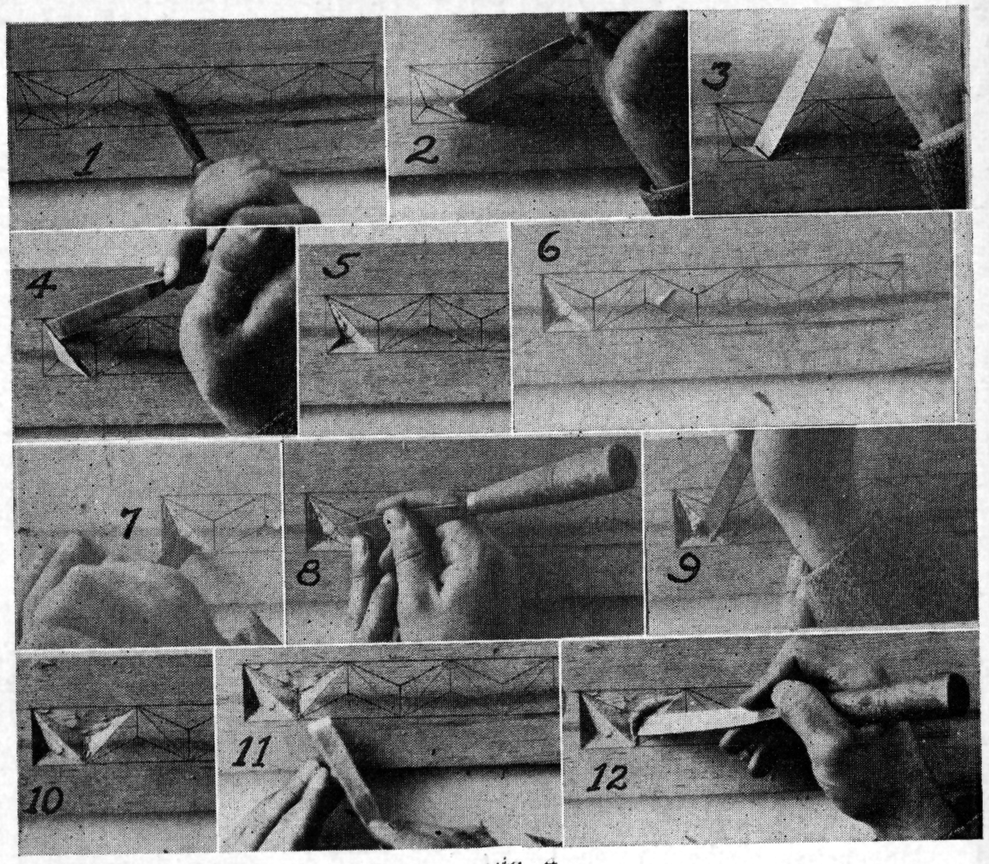


Fig. 4

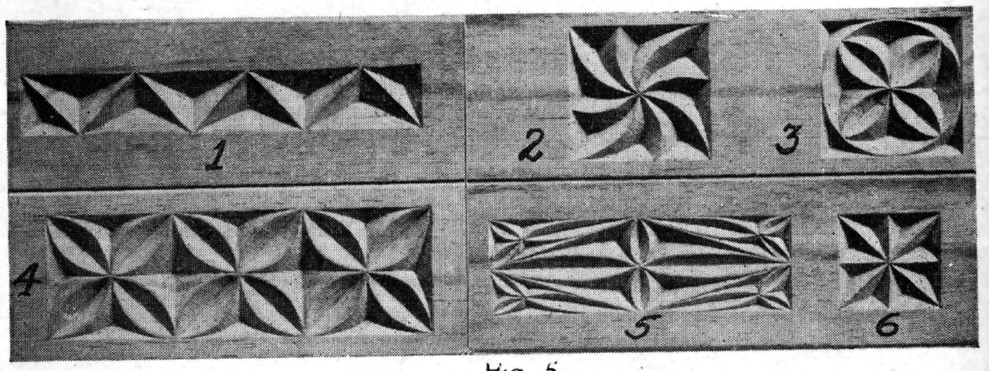


Fig. 5

In Nos. 2 and 3, Fig. 5, we find that both the stabbed and outline guide lines are curved. No. 5 shows how a design may be adapted to a rectangular area.

In carving the design shown in Fig. 6, Nos. 1 to 12 the process is a repetition of that described and with but one difference. In the former design both sets of guide lines were straight. In this one the outline guide line is curved. This involves another motion. While the same rocking motion is used from the heel to the tip of the chisel, a sweeping circular motion follows the curve of the outline.

The edge decoration shown in Fig. 7 is simple in construction

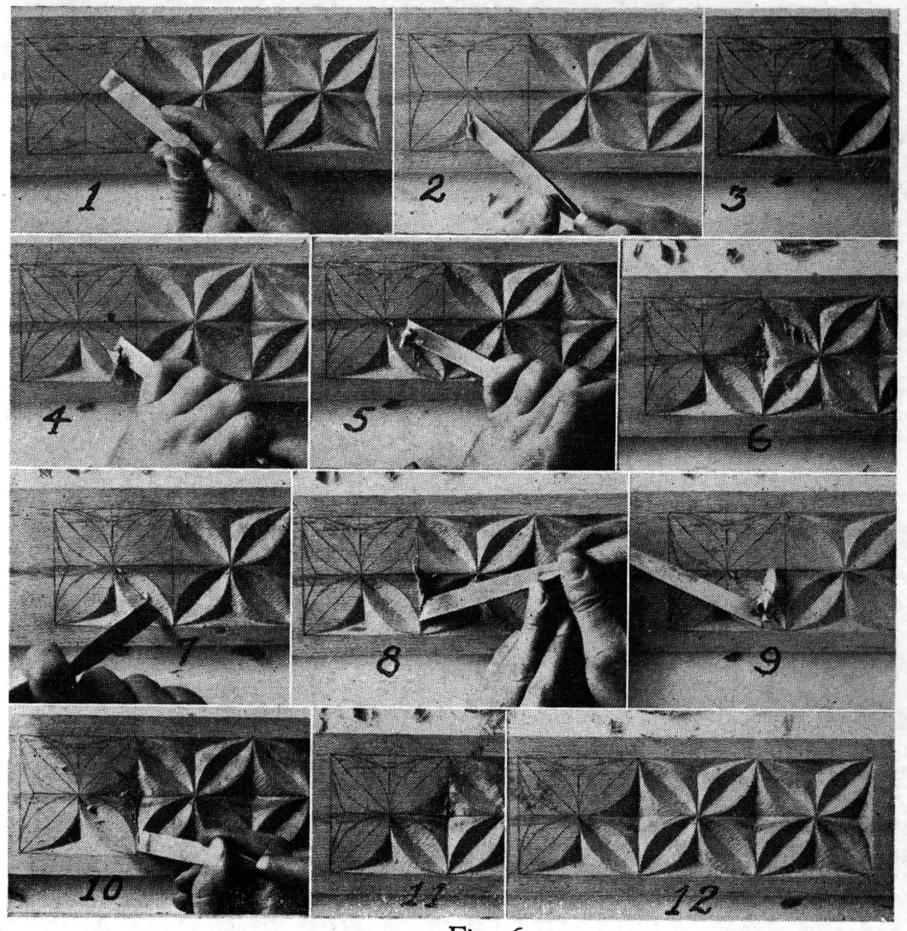


Fig. 6

and effectively used by itself or in combination with other designs shown in Fig. 5. No. 1 shows the design marked on the wood. No. 2 the method of carving first from one side then from the other to avoid splitting the

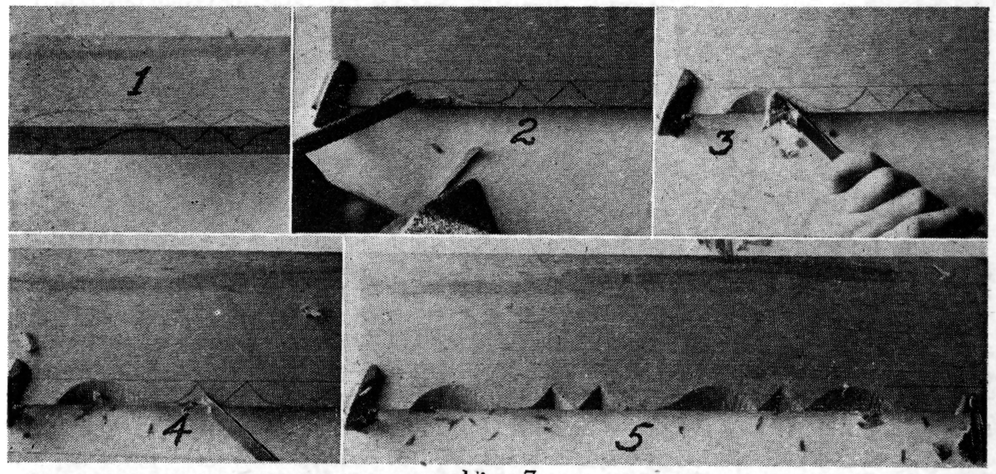
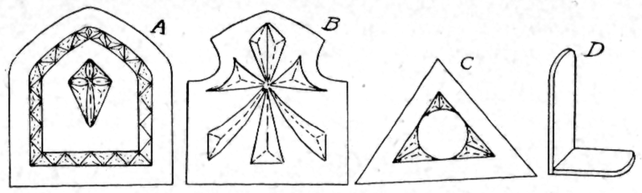


Fig. 7

grain. The roughing cut, No. 3, is followed by a light smoothing cut, No. 4. No. 5 shows the appearance of a unit which may be repeated.

PROJECT NO. 1—BOOK END

This project is primarily one in geometric design carving. The construction detail is incidental and consists in attaching a metal plate to the base with wood screws. Suggested shapes and designs are shown.



Tools: Skew Chisel, Mallet, Pencil Compass, Saw (Fret or Jeweler's), Screw Driver and Sand paper No. 1½ and 0.

Material: White Pine (free from resin), Stain and Wax, Metal Base, Felt to Cover Metal.

Instruction:

1. Cut the wood to the desired size and shape. Smooth the edges with sand paper.
2. Lay out the design, marking the guide lines as suggested on page 342.
3. Clamp the wood to a work table and with the skew chisel start the design as described on page 343.
4. Remove the pyramid shaped pieces of wood as directed under step 2 in Carving Procedure.
5. Sand the carved design lightly with the No. 0 sand paper. Moisten the wood after the first sanding to swell the grain and sand again.
6. Stain and wax, using prepared oil stains and floor wax. A rich brown stain may be made by adding two or three tablespoons asphaltum to a quart of gasoline.
7. Attach the base plate with wood screws and cover the metal with felt, using household cement to hold it in place.

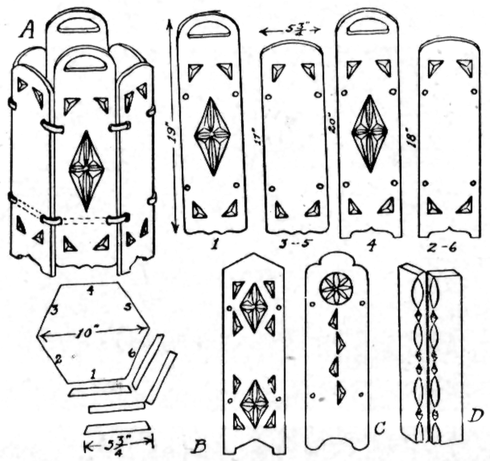
PROJECT NO. 2—WASTE BASKET

Tools: Same as listed under Project 1. Omit the screw driver and add a brace and ¼″ Drill Bit, Hammer and Plane.

Materials: White Pine, 6 board feet, ½″x6″x12″.
8 feet ¼″ Rawhide Lacing Thong.

Instruction:

1. Cut the six side pieces and the bottom of the basket, according to the dimensions given.



2. Lay out the pattern of the bottom and mark the width of the side pieces to fit.

3. Bevel the edges of the side pieces with the plane and drill the holes as indicated. Cut the hand holes in pieces 1 and 4, and shape the top and bottom ends of the other side pieces. Sides Nos. 2, 4 and 6 are made with feet. Other top shapes are suggested in Fig. 7, B and C.

4. Clamp the side pieces to the work table. Lay out and carve the design as described on page 342.

5. Finish as indicated in steps 5 and 6 outlined in Project 1.

6. Assemble by nailing the side pieces to the bottom board and lace together with the rawhide thong which has been softened by soaking in water about thirty minutes. Pass the thongs through the holes so they cover the corners as indicated in Sketch A. Draw the wet thongs tight enough to hold the sides snugly together and tie the ends.

PROJECT NO. 3—WOODEN EQUIPMENT FOR ROPE AND CORD WORK

The method of netting or cord weaving is described on page 411. The tools needed are a **needle and a mesh stick.** Construction detail follows.

The Needle used in making a hammock is shown with dimensions in Fig. 3. Maple is a satisfactory wood for this purpose.

1. Drill holes at points A-B-C-D and with a jeweler's saw cut along the outline shown in the dotted line.

2. Remove all sharp corners with a file and finish with sand paper or emery cloth.

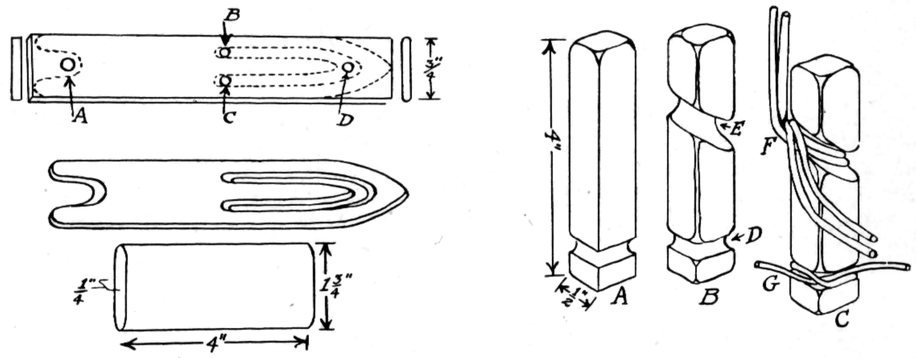


Fig. 1

The Mesh Stick is constructed as detailed in Sketch M. Any kind of wood may be used. Finish the edges with the file and sand paper.

The Tension Hook is required for Square Knot work described on page 405. Make the hook from a stick of wood 4″ long and at least ½″ square or in diameter. See Sketch A, Fig. 1. Remove the corners with a file or sand paper and cut two grooves shown at D and E of Sketch B. File these grooves deep enough to receive the tension cords as indicated at F, Sketch C, and an attachment cord shown at G. Make the attachment cords long enough to tie around the waist in which position the hook is used with greater comfort while doing square knot work.

PROJECT NO. 4—BENCH

The decoration on this project is produced entirely by carving on the edges and corners.

Tools: Skew chisel, ⅜″ straight chisel, Mallet, Saw, Brace and Bits, ¼ and 3/16, also No. 6 Drive Punch for making holes in leather straps. Sand paper 1, ½ and 0.

Materials: Stain and Wax, 2 feet Birch Dowel Pins, 5/16″.

White Pine, cut to the following dimensions:

4 pieces 2″x2″x16″
2 pieces ⅝″x3″x20″
2 pieces ⅝″x3″x16″
6 Oz. Strap Leather Pieces
7—1¼″x21″
9—1¼″x17″
32 Lacing thongs ¼″x10″ Goat Skin.

Instruction:

1. Form the tenon on the bench rails A and B and the mortise in each leg, C, Fig. 8.

2. Mark the position of the edge notches on the legs as indicated at F. Also establish the points X and Y, Sketch J. Saw cut the edge ⅜″ deep.

3. Clamp the piece to a work table and with the skew chisel cut notches in the lower edge of rails and on the corners of the legs. Place both sets of rails side by side and drill the groups of holes for the three hole fastening.

4. Assemble both double tenon rails B and the legs C. Then connect with the rails A. After the tenons are inserted and drawn up snug, drill holes and insert the dowel pins as indicated in the Sketches D and E. Bevel the ends of the protruding tenons and dowel pins as shown in D and E, Fig. 8.

5. Sand the edges of all parts as suggested in Step 5, Project 1.

6. Stain and Wax.

7. Attach the seat straps to the rails by means of the three-hole fastening. See page 81 for construction details. Punch three holes in both ends of each strap, attach one end. Dampen the strap by applying water with a wet hand or cloth and stretch the moistened strap (it must not be soaked) to bring the holes in alignment with those in the rails. Then fasten with the thongs.

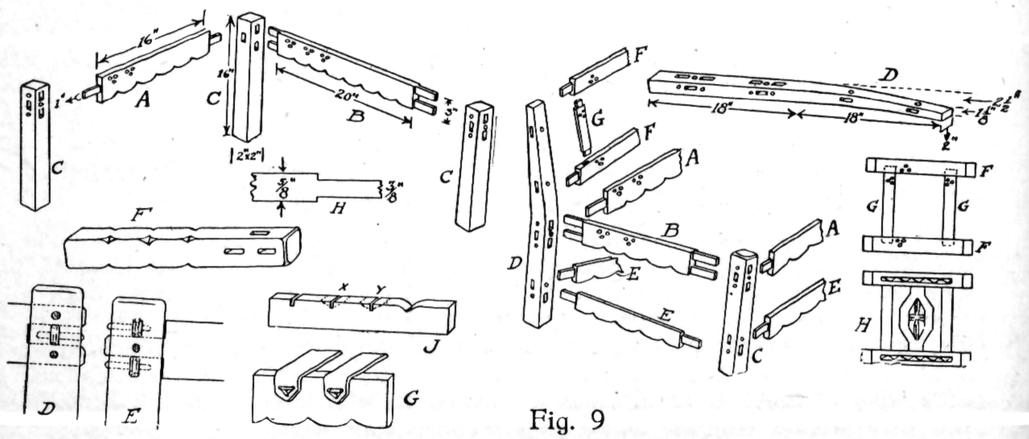
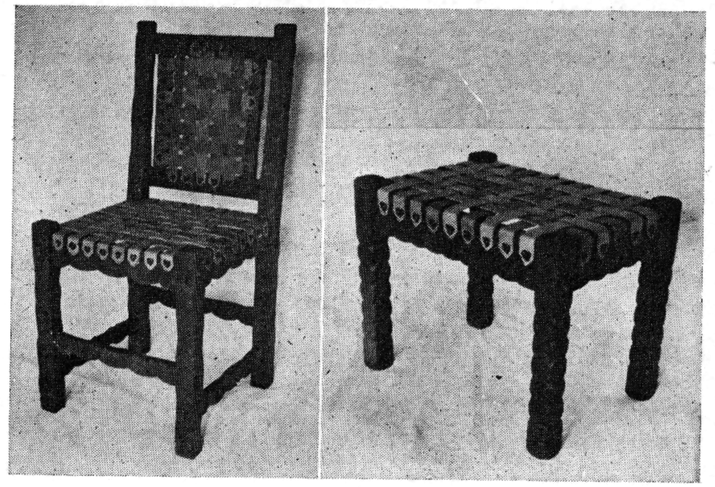


Fig. 9

PROJECT NO. 5—CHAIR

In addition to the construction used in the bench, Project 3, chair rungs and back cross pieces have been added. The carved decorations on the uprights are produced by random bevel cuts of variable lengths and depths which give a hewn effect. This may be done with a jack knife, draw knife or spoke shave. The lower edge of both the rails and rungs is treated as described under step 2 and 3, Project 4.



Tools: As listed for Project 4.

Materials:

White Pine cut to the following dimensions.

Part D 2—2″x2″—17″
Part C 2—2″x4″—36″
Part A-B 4—¾″x3″—18″
Part E 6—¾″x2″—18″
Part F 2—¾″x1½″—12½″
24—1½″x5/16″ dowels

Leather straps and thongs.
16—1¼″x18″ 6 oz. strap leather
32—¼″x10″ lacing thongs
5—1¼″x14″ 6 oz. strap leather
7—1¼″x11″ 6 oz. strap leather
24—¼″x10″ lacing thongs

Instruction:

Follow the construction detail given in Project 4. Start the assembly as shown in Fig. 9, and proceed in the following order.

1. Set the two pieces G into the mortises cut in the rails F.

2. Drive this assembly and the back rail A and rung E into the back piece D.

3. Drive the front rails A and rung E into the two front legs C.

4. Connect these assemblies which make the front and back of the chair, by driving both side rails B and rungs E into the mortises provided for them.

5. Drill the holes for the dowel pins 1½″ deep and insert the pins.

Veneers

Rare wood veneers come in thicknesses ranging from 1/28" (.0358), standard to 1/20" (.050), and in sheets of variable sizes. Veneer cutting machines or lathes produce these sheets as a log is revolved against the sharp edge of a heavy knife blade, and sections of large tree trunks are reduced to the diameter of saplings as continuous sheets of veneer are unwrapped from the log. For commercial use in furniture construction the rare or hard wood veneers are cemented in the sheet form to panels of the required thickness, which are built up of soft and cheaper woods of opposite grain and these may likewise have a desired lining surface as is the case of "plywood" used for cedar chests. The outer surface may be of walnut or mahogany and the inner of cedar with cross grain layers of soft wood cemented between. The term "ply" refers to the number of such layers.

The fancy figured veneers are obtained by slicing through a log at different angles. Fine lines and plain stripe markings in the natural wood are preserved by cross cutting logs. The so-called "fiddle back" markings are cut from quarter sawed logs. Unusual markings in veneer are obtained from tree stumps, junctions of the tree trunk and branches or sections having a wart like growth, and such cuttings classified under fancy veneers are designated as "butt", "crotch" and "burl." They come in small sizes, both lefts and rights, which may be assembled to form symetrical designs and individual panels of exotic beauty. These veneers to be found in craftwork supply stock will average 12"x36" and are sold by the piece or on a square foot basis.

Another veneer product suitable for matched panels is known as quartered veneers. These are assemblies of matched grain pieces placed in symmetrical position and held adjacent to each other by a paper backed gum tape.

THE VENEERING PROCESS

The veneering of furniture by the cementing of thin layers of fine wood to a base surface has been a specialized branch of woodwork. Only when adequate shop facilities existed, plus the skill of master craftsmen, could satisfactory pieces of veneer work be produced. For a time the term veneer was associated with inferior quality furniture of shoddy workmanship, though many excellent examples of fine artistry and craftsmanship remain, in the several museum pieces which have withstood the ravages of time, preserved for our benefit and inspiration.

The standard adhesive for woodworkers until the coming of the era of plastics, synthetic resins, was hoof glue an animal derivative which had to be applied hot and for best results in an overheated room, not under 70° F. Also pressure exerted by screw presses was required to hold assemblies until the glue set. These requirements, which prevented the average craftsman from attempting veneer work, has been removed with the perfection of the modern adhesives. The plastic cements now available are ideal for the home work shop, and the craftsman will find many satisfactions resulting from explorations in the field of wood working known as Marquetry design and construction.

*Veneering Procedure for a Marquetry Panel

Tools: Wire brads, hammer; hand drill, 1/32" bit; jig saw, saw blade, No. 105. Design sheet, carbon paper, pencil; veneer tape, square. Heavy straight edge, 3/8"x1¼"x18"; razor blade and holder. Veneer Cement and brush.

Finishing Supplies: Abrasives. Nos. 0 and 000 Garnet Paper, No. 280A wet or dry soft back paper; wood filler, shellac sticks to match veneers, wood alcohol, alcohol lamp, knife, sanding sealer. Lacquer, varnish or shellac. Spray gun for lacquer or varnish, brush for shellac, rubbing compound, wax.

*Procedure supplied by Mr. Frank D. Cardinal, Woodcraft Supply Co., 1024 17th St., Denver, Colo.

Materials: 2 pieces 1/8" plywood, pine or gum. Veneer—as many sheets of contrasting woods as color scheme of picture requires. Inlaid bands and veneer for frame of picture.

Instructions:

1. Assemble a "pad" of veneer woods, 1 sheet of each color required between two pieces of plywood. Nail through the pad with wire brads clinching the protruding points to hold the pad securely together with all sheets of wood in contact. See Sketch, Fig. 1.
2. Transfer the design to the top piece of plywood with carbon paper.
3. Drill a small hole through the pad beyond the margin of the picture, and insert the saw blade. (Be sure the jig saw table is level and at right angles to the saw blade.) Set the speed at 600 to 700 strokes per minute.
4. Saw an outline into the central area of the pattern, Fig. 2.
5. Stop the motor and remove each set of veneer pieces as it is detached from the pad Keep these units stacked together for convenience in handling. Fig. 3.
6. Assemble each picture (8 sheets of veneer yield 8 pictures, provided the colors can be used interchangeblv), on a hard surface in the manner of a jig saw puzzle, put together piece by piece, as indicated in Figs. 3 and 4.

Marquetry

7. Apply veneer tape to the face of the picture to hold adjacent pieces in position. Continue the assembly, adding a piece of veneer or more at a time, applying tape as required. See Fig. 5.

8. Mark borders on the tape covered picture, using a square and pencil to square the sides and ends as indicated in Fig. 6.

9. Trim the picture along the marked lines, using a heavy straigght edge (a piece of bar metal ⅜"x1¼"x18" makes an excellent straight edge), and a razor blade held in a metal holder. Place the heavy straight edge on the pencil line and cut through the veneer with the razor blade held in a vertical position against the straight edge. A piece of heavy cardboard or masonite press board makes a good cutting surface. See Fig. 7.

10. Place border strips of inlaid bands around the trimmed picture. The effect of a frame may be secured by placing strips of veneer of the desired width against the border strips. Permit the ends of both border strips and frame pieces to overlap. Apply veneer tape to hold them all in position. See Fig. 8.

11. **Miter the Corners.** Use the straight edge and razor blade to cut through both pieces of the overlapped veneer and bordedr strips, along the dotted line. Apply Veneer tape to the mitered corners, see Fig. 9.

12. **Attach the assembled picture** for the Marquetry panel to a suitable base. ¼" plywood, pine or gum, also Masonite pressed board are satisfactory base materials. The plywood will require a piece of veneer of corresponding thickness attached to the opposite side to compensate for the tendency to warp. Masonite does not require a veneer backing, as it does not warp. If the backing is plywood, cut it slightly smaller than the picture to permit trimming the veneer to size, see Fig. 10.

Such a picture may be used on a mantel or wall either framed or edge finished with stain and shellac. It may also be inlayed or veneered into the top of a table or tray surface.

A. Cement the picture to the plywood base. Place the picture tape side down on a level surface and coat the veneer with a thin layer of veneer cement. A cheap brush is a good applicator, since it may be discarded. Cleaning is not possible as no solvent will cut the veneer cement after it begins to set. Coat the surface of the plywood also and permit both coated surfaces to dry 30-45 minutes or until they feel dry to the touch. Place the cemented surfaces in the correct position **before** permitting them to touch. They cannot be shifted successfully after contact is made. See Fig. 11.

B. Unite the cemented surfaces by compression, produced by sharp hammer blows successively applied to a block of wood, as indicated in Fig. 12. This bonding is adequate and as the cement sets or solidifies it becomes harder and stronger with age.

13. **Remove the tape from the face of the picture.** Apply a moist cloth if necessary to loosen the paper. The adhesive on the veneer tape is water soluble and the paper tape quite absorbent.

14. **Finish Edges.** Remove any protruding margins of veneer with razor blade. The picture may be framed or the edges covered with veneer strip banding.

Finish the Veneer Surface

The procedure detailed here is applicable to any hard wood surface as well as an inlayed or veneered surface.

1. Rub the surface of the Marquetry panel which has been mounted on plywood or masonite with No. 0 Garnet paper stretched over a block of wood. This reduces any unevenness due to variable thicknesses of different veneers used. Then rub with No. 000 Garnet paper, see Fig. 15.

Marquetry

2. Inspect the sanded surface for small open spaces, saw kerfs between adjacent pieces of veneer, or tiny edge breaks. Fill these with stick shellac of matching color. Stick shellac comes in a wide range of colors closely matching the colors found in rare woods. The point of a knife blade heated in the flame of the alcohol lamp to a temperature just sufficient to melt the shellac when pressed against the stick is used to convey a small quantity of shellac which is pressed into the space to be filled. Smooth off any excess with the knife blade and sand it down with the No. 000 Garnet paper. See Figures 16-17-18.

3. Apply wood filler, using a cloth as an applicator. Natural color is used for light colored woods and filler stained with burnt umber to dark colored woods. (The filler in powder form may be mixed with dry umber and added to boiled linseed oil to form a paste of a creamy consistency.) Rub off surplus with a soft cloth applied across the grain.

4. Apply with a brush a light wash of white shellac (one-half strength, dilute with wood alcohol). When dry rub with fine steel wool to remove any brush marks or bubbles.

5. Apply with a brush a coat of sanding sealer. When dry (about an hour) rub with No. 280A abrasive paper. Repeat this step once or twice if necessary to produce the desired surface.

6. Finish either with (a) lacquer, 2 coats, sprayed on, or (b) varnish, 2 coats, sprayed, or (c) shellac, 2 coats, may be applied with a brush or spray gun. Rub each coat of finish with (a) rotten stone and water, or (b) rubbing compound. Finally wax the finished surface.

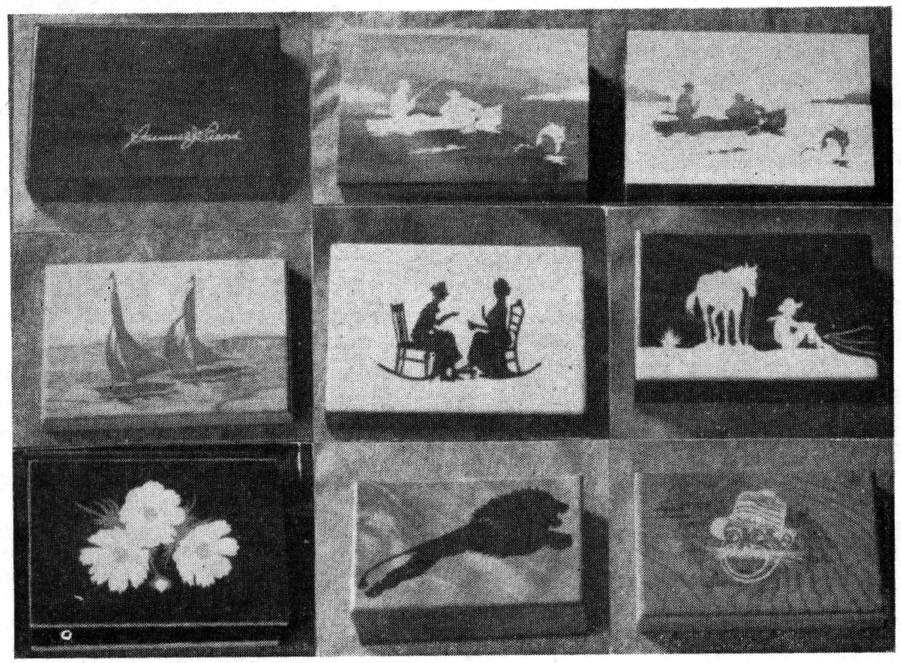
Inlay as the name denotes refers to the process of setting a piece of material into a cavity of the proper size, shape and depth cut into another material. Woods of contrasting colors and grains, pieces of shells, bits of ivory, metal and other substaances have been used as inlays in wood.

Overlay refers to the process of covering one material with another. The woodworking process of placing "a thin layer of choice wood upon a commoner surface" is an example of overlay which is known as Veneering."

Marquetry is the name given to assemblies of different woods arranged to form design motifs in area decoration. Veneers for Marquetry and Inlaying are suppied in thicknesses from 1/16" to 1/4". A marquetry assembly may be made of veneers selected for color contrast and held in position by gummed tape until they may be cemented as a unit to a suitable base. Such marquetry assemblies of different designs for furniture are available commercially. The "picture in wood" is a project in marquetry which has special appeal for the craftsman and designer in the fascinating process of planning a design suitable for development in wood and executing it with the desired scheme of color and form chosen according to the natural markings and colors of the available rare woods. The photograph shows a collection of marquetry decorated boxes, designed and constructed by Mrs. E. E. Horton of Santa Cruz, California, through whose courtesy the illustration appears.

The method employed in the construction of the boxes shown in the illustration is the special technique developed and perfected by Mrs. E. E. Horton. We are greatly indebted to her for this information and for the privilege of presenting the story of her achievement as an example and inspiration to other craftsmen. Again we recognize the mark of a master craftsman in the spirit with which these precious skills are shared with others.

Some seven years ago Mrs. Horton began, as a hobby, experimenting with Marquetry inlays. This absorbing activity grew as her skills developed and techniques were perfected. Her artistry and unusual craftsmanship combine to give that superior quality to all of her craftwork, which is recognized and sought by famed gift shops such as Pusey's of New York, Gumps and Whitney's of San Francisco. As friends who were delighted with gifts of her work praised it to others, she began accepting orders for the reproduction of photographs and the inlaying of signatures and emblems for the decorations of the small boxes which are her speciality. Three



years ago she was persuaded to have a display at the gift shop of the Yosemite National Park, and since then orders have come to her from many places and contributions of rare woods from foreign countries are sent her by friends and craftsmen, who appreciate the joy and satisfaction this unique hobby gives to the creator and to the recipients of her mastterpieces in wood.

PROCEDURE FOR MAKING SMALL MARQUETRY BOX

Tools: Jeweler's Saw, No. 8/0 Saw Blades, Circle Saw, Jointer, Belt Sander. 1" strips of rubber inner tube, 3 to 4 feet long, Glue, French Caignet (kept fluid in a double boiler).

Materials: Box size 3½"x5½".

Box Frame:

2 pieces wood, 5½"x1⅜"x5/16" for Sides
2 pieces wood 3½"x1⅜"x5/16" for Ends
3 pieces hard wood 3½"x5½" contrasting for Top
1 piece hard wood 3/32" thickness for Bottom
2 pieces 1/16" for Marquetry
1 piece ⅛" for Base

Abrasives: Garnet Paper Nos. 1/2 to 2/0, or Carborundum paper Nos. 60 to 100. Trimite, wet or dry paper, Nos. 130, 150, 220, 240, 280, 320 and 400.

Finishing Supplies: S. W. Sanding Sealer No. 684, S. W. Lacquer No. 67, S. W. Rubbing Compound.

Instruction:

1. **Make a Box Frame** with mitered corners from selected wood, cut to the dimensions indicated above. The jointer is used to reduce uneven sections of wood to the proper thickness, and the corners are mitered on the circle saw. Test the cut for proper angle before cutting the frame material.

2. Apply hot glue to the beveled edges and place the side and end pieces together, see Sketch A. Hold in position and under pressure contact with a strip of rubber wrapped as shown in Sketch B, unttil the glue sets—24 hours, before releasing pressure.

3. **Finish the frame,** both inside and out.

A. Sand the outside of the box frame on a belt sander. Sand the inside by hand, applying the abrasive paper stretched over a small block of wood. First use No. ½ garnet paper or No. 50 carborundum then No. 2/0 garnet or No. 100 carborundum paper. Follow with a light application of each abrasive by hand, using in turn Nos. 130, 150, 180, 220, 240 trimite dry.

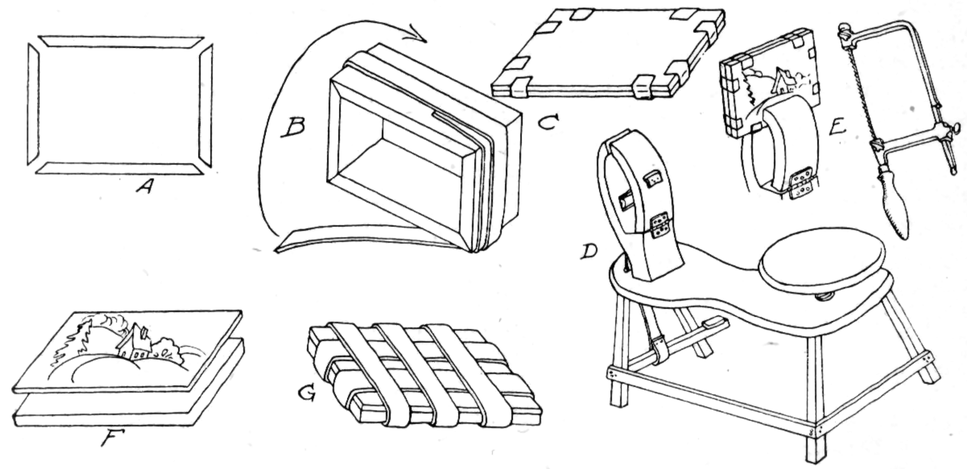
B. Apply a filler, sanding sealer S. W. No. 684 to all surfaces in a room temperature 70° F. or above.

C. Sand with No. 320 trimite dry.

4. **Make the Box Cover,** using two pieces of wood in contrasting colors.

A. Place two 1/16" thick pieces, (usually the lightest colored) wood on top and hold in place with scotch tape applied to the edges, see Sketch A.

B. Trace the design on the wood with carbon paper, using a sharp 3H hard pencil.



C. Saw to outline with a 5" jeweler's saw, using a 8/0 saw blade. Saw into the design from the edge of the wood, following along a border line. If the design area is not adjacent to a border line it is necessary to pierce an opening to receive the saw blade. A hole may be drilled but this requires the replacement of the drilled piece or unsightly patching. With care it is possible to work a tiny slot into the grain of the wood with the point of a fine needle mounted in an awl handle.

As a rule, the jeweler's saw is operated vertically with the work held in a horizontal position on a V notched block extending over the edge of a table. Mrs. Horton holds the box top in a vertical position in a foot controlled vise similar to the harness maker's stitching horse as shown in Sketch D.

Marquetry

The saw is operated in a horizontal position and the saw blade teeth point so that the saw cuts on the forward stroke. See Sketch E. The vertical foot-controlled vise, cloth lined to give better ggrip without marring the work, permits its adjustment into any position in the vertical plane during the sawing operation, so that the direction of the cut is always downward with the saw at right angles to the work.

D. Remove the areas cut in sequence. Small areas, as "dots" in signatures, may be lifted out of the hole with a moistened needle point.

E. Apply wood filler (sanding sealer) to the back of the insets as they are transposed from one piece to the other. This method yields two cover marquetries. The photograph of the fishermen shows the effect produced when contrasting woods are transposed.

F. Attach the marquetries to a hardwood base, 1/8" thick, to form the cover assembly. See Sketch F. Apply hot glue to both surfaces, press into contact and hold in position with wide rubber bands, Sketch G.

5. Attach the Assembled Box Cover and base, 3/32" thick, to the box frame. Sketch H.

A. Test for perfect contact and sand any uneven places. Apply hot glue to the upper edge of the box frame and press it against the bottom piece. Then apply glue to the other edge of the frame and press the cover into position. Wrap the box securely with rubber bands and permit the glue to set for 24 hours, Sketch G.

6. Finishing Procedure.

A. Sand all surfaces of the box using abrasives applied as specified in step 3, a-bc, see Sketch J. Round the edges of the cover slightly during the sanding procedure as indicated in Sketch K.

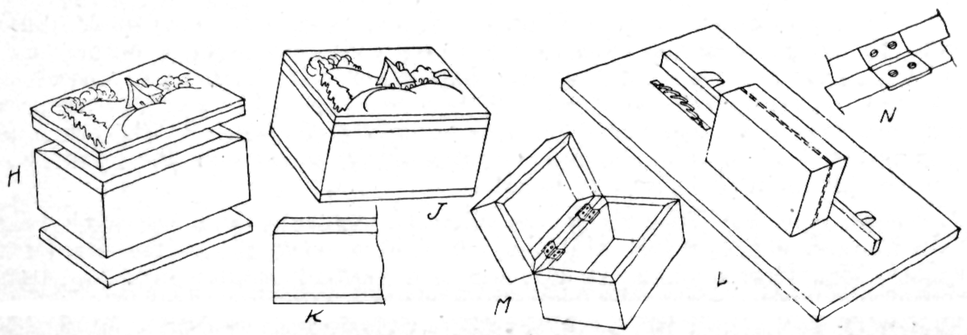
B. Apply a coat of sanding sealer, S. W. No. 689, in a room temperature of 70° or above, and rub this with No. 320 trimite, used dry. If the woods are absorbent apply a second and third coat of the sealer, after rubbing each time with the trimite paper.

C. Build up a lacquered surface using S. W. No. 67 lacquer. Brushed, preferably sprayed on, allow the lacquer to dry at least one hour. Rub well to remove brush marks with No. 400 trimite paper moistened in water. Dry the surface with a soft cloth and polish with rubbing compound. Repeat the procedure until the desired surface is obtained. Consider three coats of lacquer as the minimum. Mrs. Horton uses six coats.

7. Cut the Box Apart on a circle saw following a line which makes the top approximately 5/8" thick. See Sketch L. Sand and seal the cut edges. Apply one or more coats of lacquer.

Remove any excess glue from inside surfaces. Sand and seal all interior surfaces and finish with one or more coats of lacquer. A wax finish may be used on the interior surfaces applied directly to the sealed and sanded surface.

8. Attach hinges with screws as indicated in Sketches M and N.



PINE FURNITURE

The accompanying photographs show several pieces of furniture designed and finished in the Spanish Colonial style. The hand carved decorations on the theatre furnishings and the chests embody some of the principles of carving described in the foregoing pages.

Sturdy construction is obtained by utilizing the dovetail, mortise, tenons, pegs and wedges, which was the type of construction employed by the Spanish Colonial Craftsman whose only wood was pine. All surfaces are hand hewn, stained, highlighted and waxed. Some of the carved decorations are enriched by wiping out the encised areas with colored pigments.

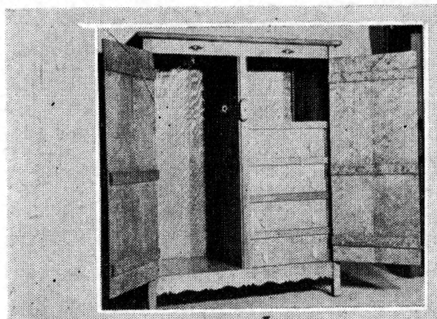
The cushion and pillow construction appropriate for this type of furniture, consists of a loose cushion spring filled unit padded with curled hair. Depending on use the cover material may be any hand woven fabric —Chimayo blanket with finger woven designs are effectively used— Denims also are effective, but the choice is genuine Mission Grain Steerhide in the natural or russet color. Many fabrics resembling leather are on the market and a good grade of this material will give long service.

These cushions may be suspended on a stretched rope (Manila 3/8" diameter) support laced with a 3 to 4 inch spacing between ropes.

A few styles of several pieces of pine furniture are shown in the scale drawings shown on page 363.

This style of furniture is suitable for Spanish Colonial, California Mission, Pueblo, Indian, and Pioneer type homes. Ranch house, mountain cabin, den and recreation rooms may be furnished appropriately with this type of furniture which can be constructed in the home workshop with a minimum of equipment. The primitive touch is retained without the sacrifice of comfort or refinement

The cushions and pillows are covered with material hand woven according to the Spanish Chimayo method described on pages 249-250.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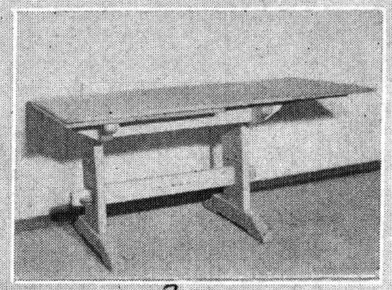
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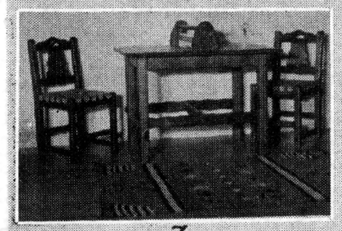
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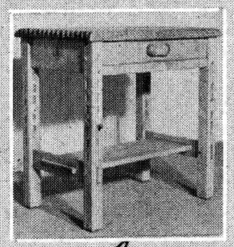
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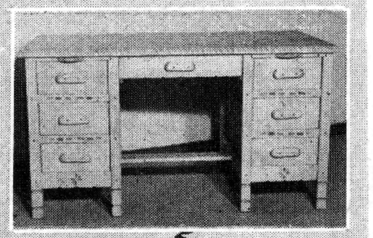
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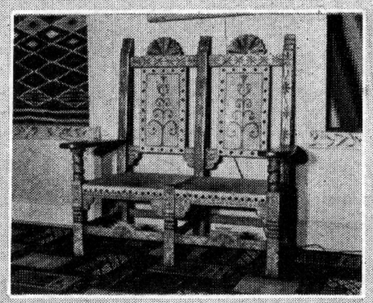
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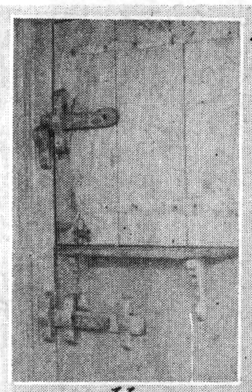
1. Wardrobe.
2. Refectory Extension Table.
3. Writing Table, Studio Chair.
4. Side Table.
5. Desk.
6. Book Case.
7. Magazine Table.
8. Studio Chairs, Strap Laced Seat, Dogie Rawhide, hair covered seat.

9-10. Foyer Furnishings—UTE THEATRE, Colorado Springs.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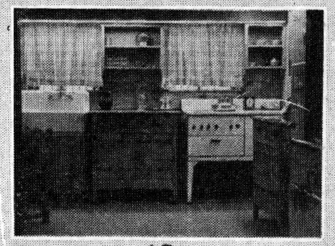
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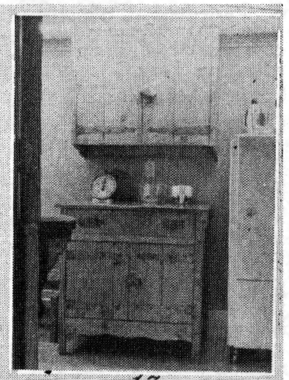
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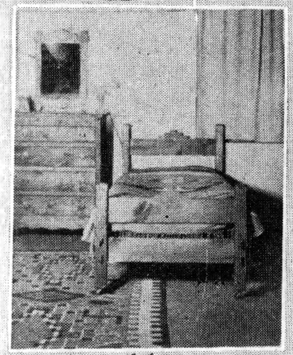
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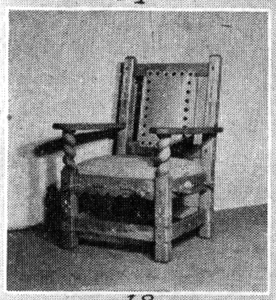
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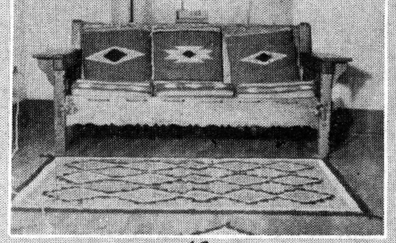
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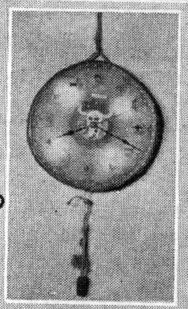

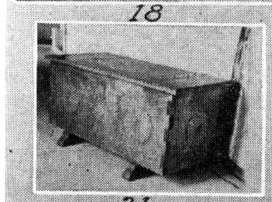
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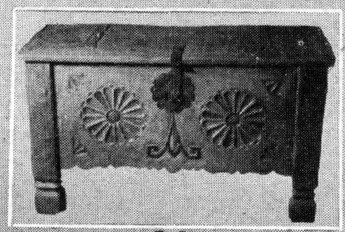
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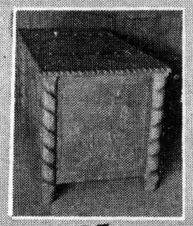
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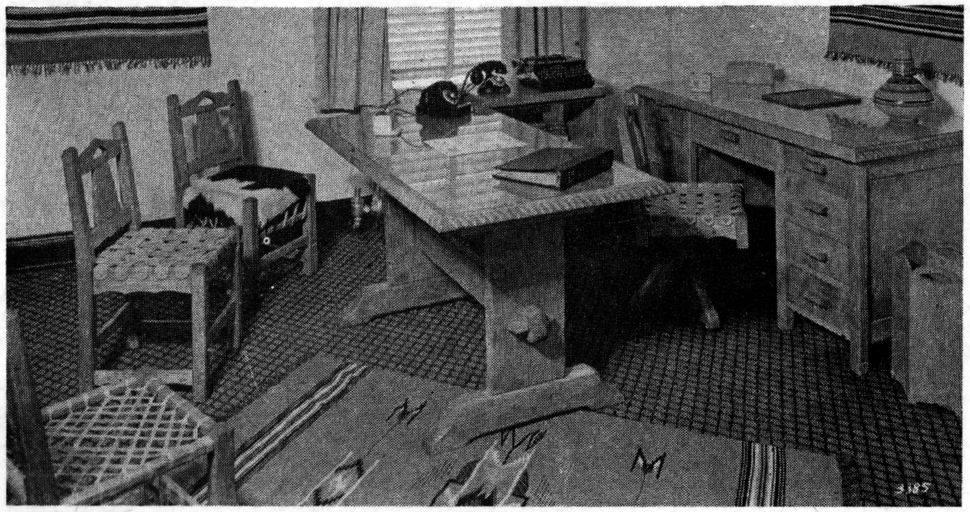
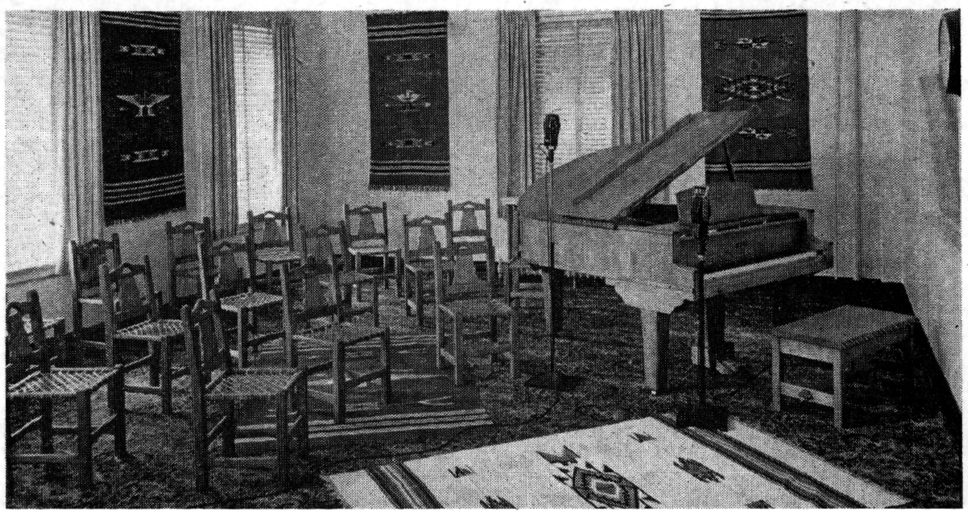
11. Double Door, Latch String Catch, Slide Bar, Fastening Devices.
12. Kitchen Shelves, Cabinet.
13. Kitchen Cupboard and Cabinet.
14. Bedstead and Dresser.
15. Sideboard.
16. Hanging Cupboard, Rope Suspension.
17. Serving Table.
18. Arm Chair—Loose spring-filled cushion, rope suspension.
19. Divan—Loose cushions, spring-filled, Chimayo blanket, Pillow and Cushion Covers.
20. Electric Tom Tom Clock.
21. Chest—Dovetail Corner Type.
22. Chest—Corner Post Type.
23. Chest—Rope Carved Post.

PINE FURNITURE

The offices and studios of the Mutual Broadcasting Company—KFEL—Denver, Colorado, are furnished in pine. This installation was designed by the author, and constructed under his supervision. Office furniture, chairs, table, desk, and other furnishings are shown in the accompanying photograph. Three styles of a studio type chair—a rawhide thong laced seat, a woven strap leather seat attached by leather thongs, and the "dogie" or "cowhide with the hair on," seat attached with a thong tom tom technic, are pictured. The table is of the pedestal type with pediment and stretcher, mortised, tenoned and pegged. Plate glass tops are used on both the desk and table. A border strip of pine is set into the table top to frame the plate



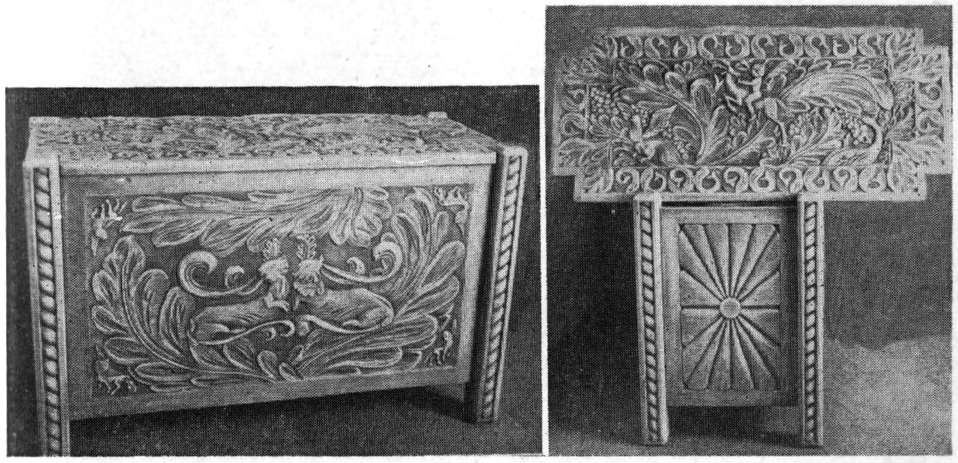
glass. The strip is mitered at the corners and the rounded and "pie crust" finish applied to both the strip and the table top. This inset strip reenforces the table top and adds to its appearance, especially at the ends where it cuts the wood across the grain. The table top is finished under the glass to preserve a uniform appearance. The waste basket, also of pine laced together with a rawhide thong is finished to match. Construction details are to be found on page 346.



The KFEL studios are in the Albany Hotel and visitors are always welcome.

PINE FURNITURE

The studio furniture includes a baby grand piano which is pine covered to carry out the specifications of "everything in pine." All detachable parts were replaced with pine lumber. No veneer was disturbed to avoid altering the acoustics. The curved body contour is made of 3/8" pine boards in random widths which are set into a groove in the top and bottom rails. Lighting fixtures of the semi-indirect type are made of clarified rawhide in the tom tom style.



The four post type chest is an example of a prevailing style in chest construction found in the Southwest. The rope work decoration in the post and in the carved panels is accentuated by the finish which is antique ivory, that has been highlighted by rubbing.

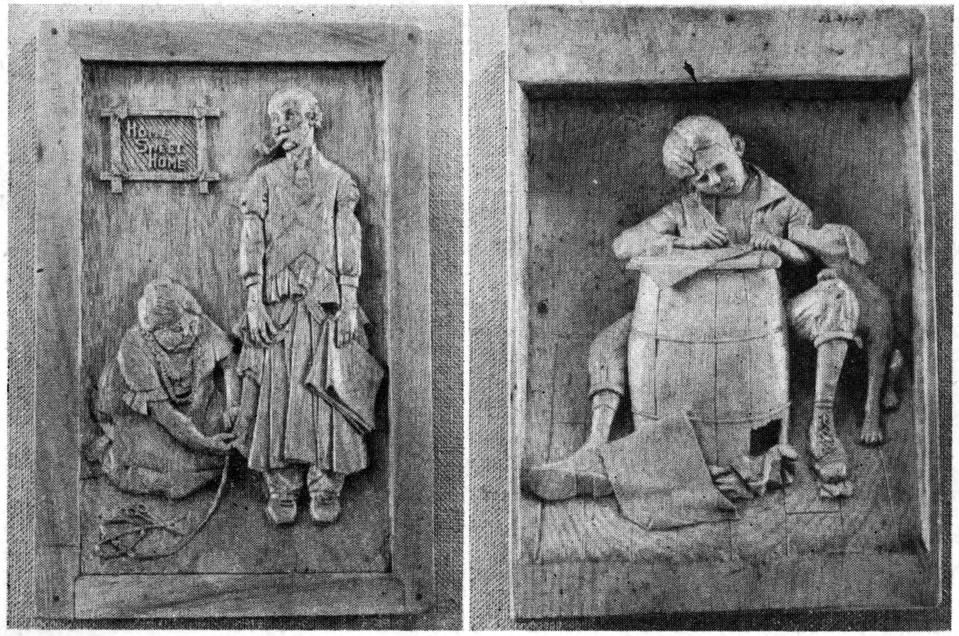
This finish is particularly adaptable to pine wood. It consists of white lead in oil. A thin priming coat is applied first, and followed by a covering coat. When this second application is almost dry, slightly tacky, powdered burnt umber is dusted on all surfaces. Later when dry all surfaces are rubbed with a linen cloth, then wax polished.

The dovetail corner style chest is typically Spanish Colonial in construction. The top is also dovetailed to the end battens, which are attached to the chest with a wooden peg hinge.

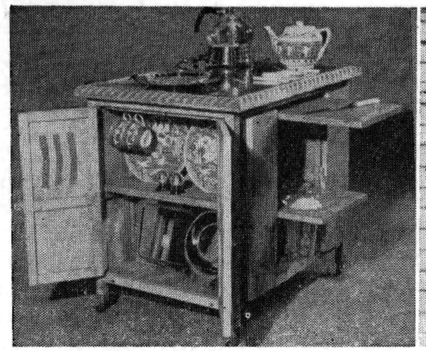
The carved panel is a bit of handicraft by Eva Clark Keller, the artist who has illustrated many of the processes and technics portrayed in this manual.

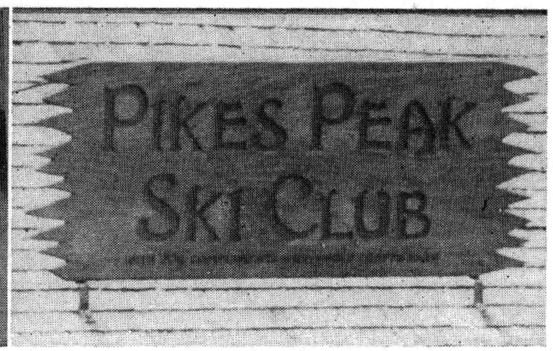
WOOD WORKING

Figure Carving



The carved plaques are Saturday Evening Post Cover designs interpreted by relief carving in pine by John Watson Spafford, a fifteen year old boy. The interpretation of a good subject often permits a beginner to proceed with the wood carving before he is competent to create his own design.



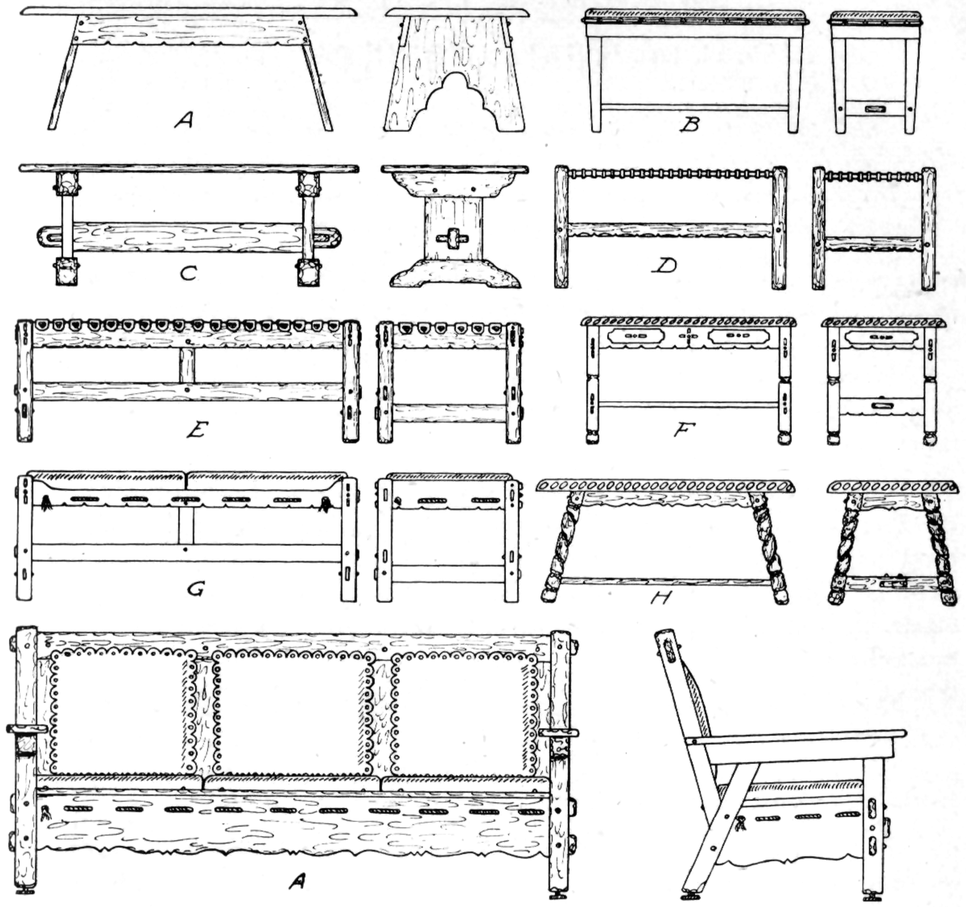


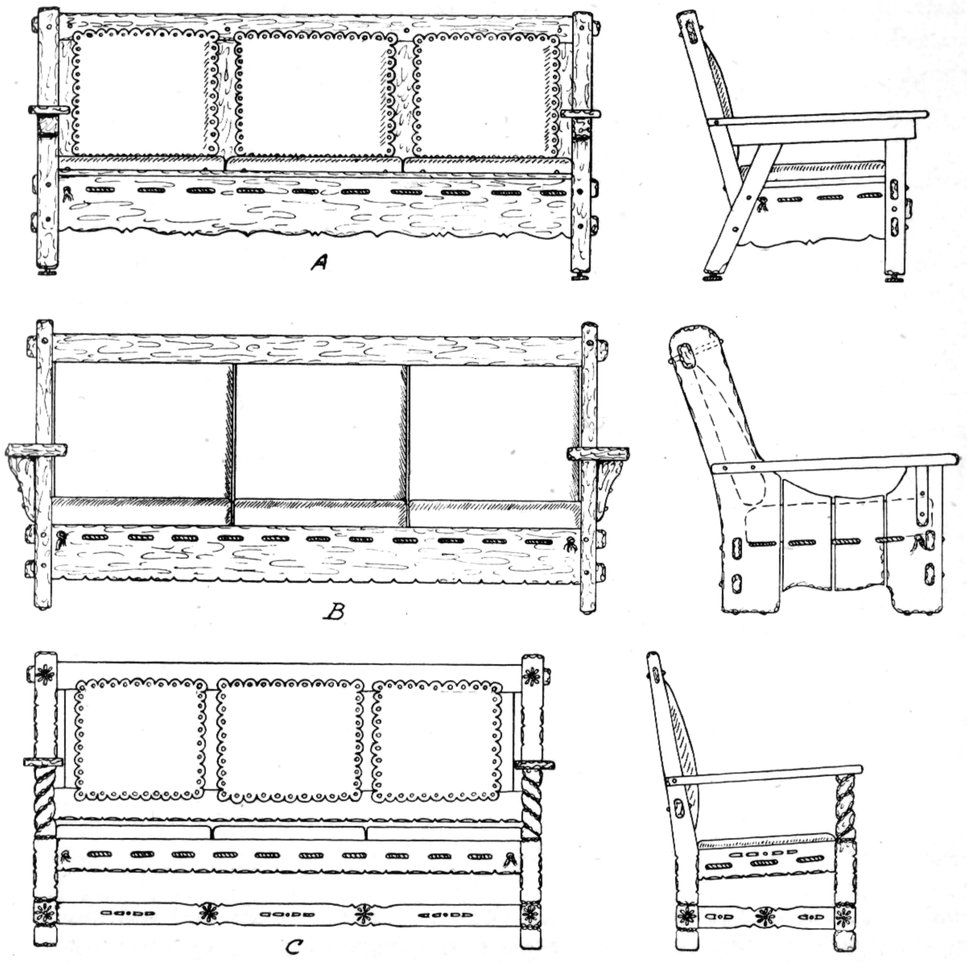
The "mesita-trostero," or little table cupboard is a worthy successor to the erstwhile "tea wagon." Space utilization in this unit is maximum. It occupies a floor space of 20"x30"—houses a complete China and silver service for eight persons. It also provides storage space for a glass coffee maker, a waffle iron and a grill toaster.

A complete meal can be prepared and served cafeteria style in a small room. Four sets of cupboard doors make the interior accessible from all sides.

The Pine Sign with routed letters, stained to resemble the branded or burned letter, makes a primitive yet dignified marker. The wood surface is hand hewn, stained, oiled and water proofed with Spar varnish.

PINE FURNITURE





Pine Furniture

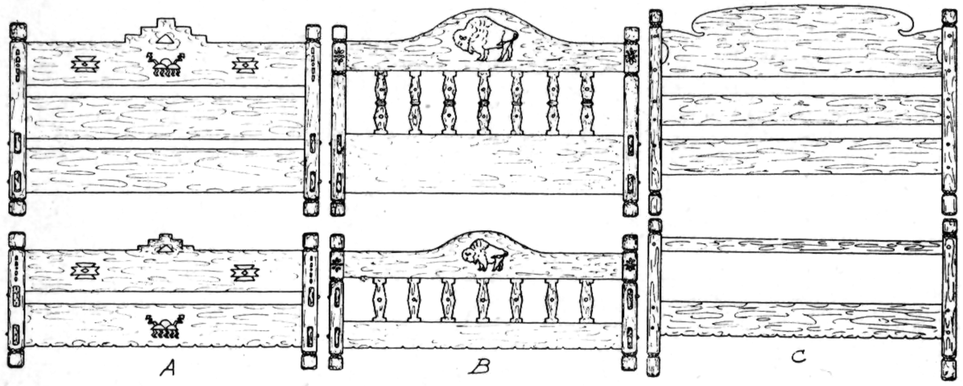
Eight styles of benches are illustrated in scale drawings on page 263. In sketch A the end supports are single pieces, cut from a plank, and secured by side rails recessed into the end pieces which are set at an angle or "splayed" for strength and stability.

Sketches B, D, E, F, G, and H show four styles of a four post type bench. B is a tapered leg, cross stretcher style with a padded seat. D is a square post type bench with a rawhide thong laced seat. In sketch E, the seat is made of leather straps attached to the end and side rails with goat skin thongs, which are laced thru holes drilled in the wood. Detail of this three hole fastening is given on page 81.

The benches shown in sketches F and H have solid wood seats attached to the side and end rails with wood screws, counter sunk and concealed by hard wood dowels. The rounded edges of the seat boards are gouge cut with the "pie crust" decoration. Chip carved designs may be applied to either the straight or splayed legs, or they may be carved to resemble twisted rope.

Style G is similar in construction to style E, but has a side rail of sufficient width to enclose spring filled cushions which are supported by a taut laced rope. Bench style C is a pedestal type braced by a cross stretcher mortised, tenoned and wedged.

The three divans A, B, and C are designed to take spring filled cushions on rope supports. The back pads are covered with heavy cowhide attached with large headed wrought iron nails. In style B the back cushions are steerhide covered.



The bed steads in sketches A and C illustrate two styles of cross head board construction, while style B shows a slat type. All three are assembled with demountable side rails constructed with double tenons which are held in the mortised corner posts with dowel pins.

Rope—Cordage

This chapter was prepared by Mr. J. M. Drew of the Extension Department of the University of Minnesota, a veteran Scoutmaster and Craftsman. For many years the study of knots and their uses has been his hobby and he is today the authority whose existence he questions.

There have been in past years a number of experiment station bulletins written on the subject of the use of rope on the farm and the making of knots and splices. The Station at Cornell University issued a good bulletin on this subject something more than twenty years ago and immediately thereafter there seemed to be a sort of epidemic of rope bulletins, and a number of stations published bulletins of this kind. Some were evidently written by men who did not know the ropes, as the sailors say, and some rather ridiculous statements were printed.

There seems to be no such thing as an authority on the subject of knots. Even the two or three books used by our Naval Academy disagree in some particulars.

The main reason, I suppose, why we have no real authorities on this subject is because the sailors, who made the most use of knots, are not the kind of men who ever put anything on paper.

The purpose of this chapter is to illustrate the best methods of making some of the most useful knots and splices. No attempt will be made to show all of the knots known to the sailor or even to list them, but the most useful knots and the easiest way to make them will be shown. It is the hope of the author that the illustrations and brief description of each knot and splice will enable the beginner to easily master them.

Rope

The most common materials used for making rope at the present time are Manila and sisal. A generation or two ago American hemp fiber was used very largely in the making of rope but Manila and sisal fiber can now be obtained so cheaply that the labor cost of producing hemp fiber has put it out of the market. Cotton rope is used in a limited way for certain specific purposes but ordinarily Manila or sisal rope are the only kinds found on the market.

Manila fiber, often wrongly called Manila hemp, is obtained from the leaf and leaf sheath of a kind of banana palm native in the Philippines. There are several varieties but all are known by the general name of abaca. The plants grow from eight to twenty feet high and the leaf sheaths grow from five to twelve feet in length. These are cut into thin strips and the pulp scraped away under a knife held by a spring against a block of wood. After drying in the sun the fiber is tied in bundles and taken to the market.

Manila fiber is the material used for the best grade of binder twine. Owing to its great strength it can be made to run 650 feet to the pound as compared with 500 feet in the case of sisal.

The sisal plant, known as henequin in all Spanish speaking countries, is a native of Yucatan. It is a plant somewhat resembling the century plant and is propagated by suckers springing from the roots of the old plants, or by sets like onion sets which grow on the flower stalks. The fiber is found in the leaves and is separated by scraping and washing. The fiber is from 2½ to 4 feet in length and stands next to Manila in strength. It is much harsher and stiffer than Manila, and is used very largely in mixtures with Manila fiber in making binder twine and rope.

Manila fiber as it comes from the bale will average between six and twelve feet in length. Sisal fiber is seldom more than two or three feet in

length. Manila rope is much stronger than sisal and is softer and more pleasant to handle. Experiments now being tried, however, seem to indicate that sisal rope wears better than Manila where it is used in running over pulleys, and it seems to stand exposure to the weather better than Manila.

Taking New Rope from a Coil

The proper way to take rope from a coil is to draw it from the middle. There are two ways to do this—a right and a wrong way. If it happens to be done the wrong way the rope will become twisted in a manner that will make it almost unmanageable. If done the right way it will come out without any twisting or snarling and all the rope in the coil may be drawn out without trouble. To do it properly the rope should be uncoiled toward the left, or opposite the way the hands of a watch or clock run. By finding the inside end of the coil and observing how it uncoils, one may tell whether or not he is starting in the right way. If the rope uncoils to the right instead of the left the whole coil should be turned over and the end pulled through from the opposite side of the coil. The rope will then uncoil to the left and cause no trouble.

New, Stiff Rope and How to Cure It

A new rope, particularly if it be sisal, often causes trouble because of its stiffness. If used as a hay-fork rope, or in any place where it runs through a set of pulleys, it is apt to be troublesome until it has been used for some time. This trouble may be avoided by boiling the rope in water. The plan usually used is to coil the rope in a boiler or large soap kettle and cover with water and bring to boiling heat. The rope is then stretched out and allowed to dry, when it will be found to be soft and pliable. Manila rope is usually soft enough to use without such treatment.

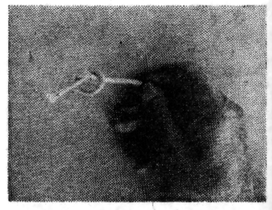
KNOTS, HITCHES AND BENDS

Properly speaking, what are commonly called knots may be placed in three classes, knots, hitches and bends. The old-time sailors had rather definite ideas about these three classes but did not draw very sharp lines between the classes as shown by some of the names. For example, some confusion is caused by calling some bends hitches and some hitches bends.

In case a rope is attached to a spar, a post or any other such object, the knot so used is called by the sailors a hitch. For instance, a clove hitch, a timber hitch, a halter hitch. When two ropes are joined together, the knot is called a bend. For example, the carrick bend, the sheet bend, the reeving line bend. A sailor speaks of bending the sheet to a clew of a sail, the sheet in this case being the rope used in holding the sail in place and not the sail itself as landsmen often think.

Overhand Knot

The simplest form of knot is shown in the accompanying cut. It is the so-called overhand knot and may be right-handed or left-handed. A sailor seldom uses this knot alone but it is used in combination with some other knots as will be shown later. The most common uses of knots are in tying two ropes or cords together, in tying up packages, or in making ornamental knots which may at the same time be more or less useful.



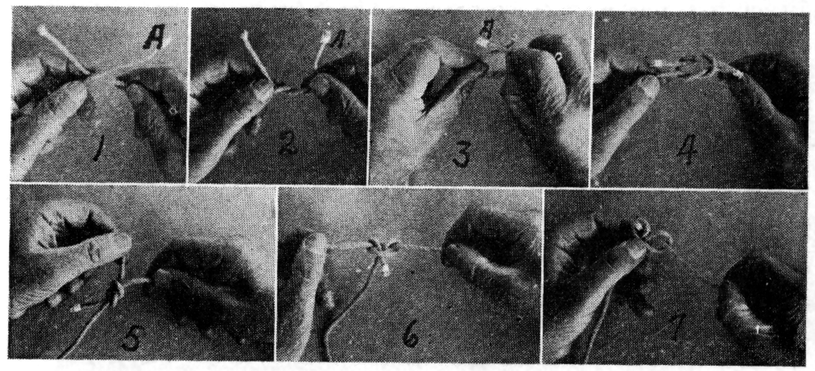
The Square Knot

The knot which has probably been tied more times than any other since the beginning of time is the square, or as the sailors call it, the reef knot. The proper way to tie it is shown herewith. The ends are first crossed as in Fig. 1 and the end marked A is turned once around the

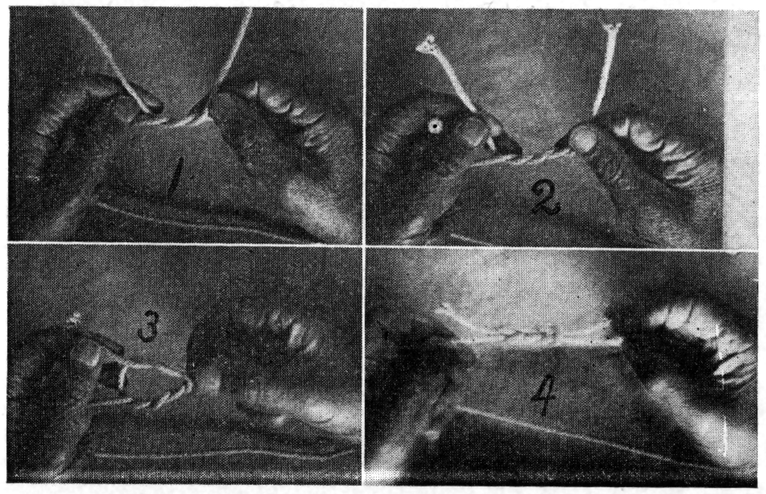
standing part of the other cord as shown in Fig. 2. Notice that this turning is done in the same direction as one would turn the crank of a pencil sharpener. The same end is then turned in the same direction around the end of the other cord, which has been bent over as shown in Fig. 3. Fig. 4 shows the completed knot.

It is the knot we use or should use in tying our shoes every morning; only this form of the knot differs from the reef knot which the sailor ties, in that we use a bow or bight instead of the end of each string in the act of finishing the knot.

We often see the statement in print that the square knot is the safest knot we can tie in doing up a package or in tying lines or ropes together. This is a very misleading statement and is not true at all as we may readily see by looking at the series of cuts shown herewith. The



square or reef knot is always used by the sailors in tying the reef points together when a sail is furled. In a position like this the knot is a perfectly safe one because it is in no danger of being disturbed but if one end is pulled as shown in cut 5, the nature of the knot is altogether changed; instead of a square knot we have what the sailors know as a larkshead which is simply two half hitches in one rope around the other, and can easily be pulled apart. If the string about a package is tied with a square knot and one end gets caught in something and is pulled out straight, the square knot is spoiled and becomes of no use as far as holding the package together is concerned.

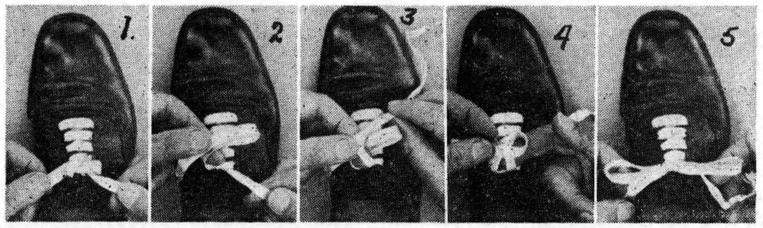


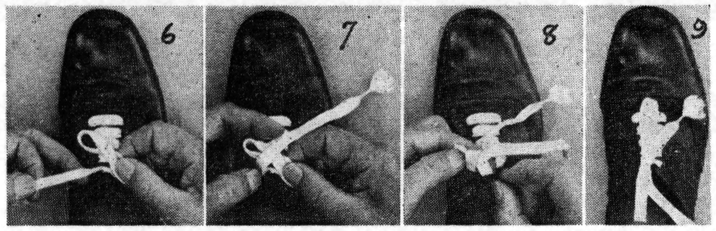
Surgeon's Knot

A modification of the square knot, known as the surgeon's knot because it is used by surgeons in tying arteries, is often used in tying packages. The end used in tying is passed twice around the other cord instead of once as in the square knot (see Figs. 1 and 2), then twice around the other end as in Figs. 3 and 4. If pulled up snug it makes a safer knot than the square knot.

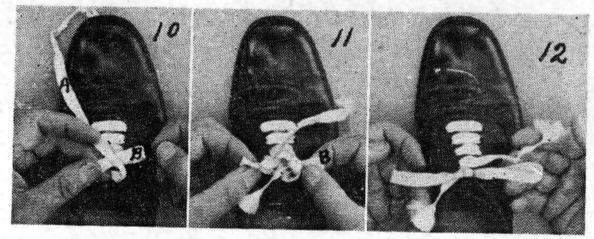
Shoe Ties

It would seem that anyone old enough to read this book should have learned how to tie his shoes; but we see so many shoes that are incorrectly tied, and so many that so often come untied, that possibly it is worth while to show the proper method. In this series of pictures a pair of white ties is used on the black shoes, not because the author considered it a beautiful combination but because on account of the contrast the method of tying



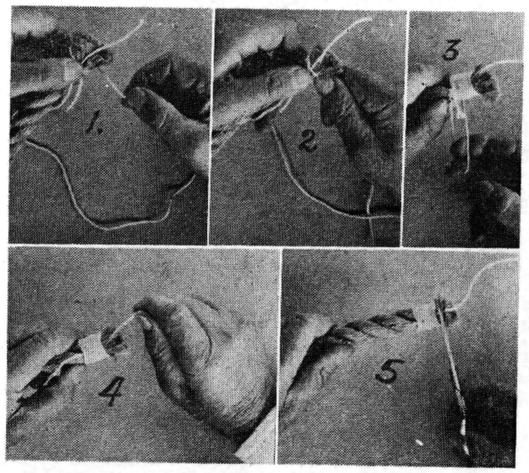


could be easily seen. The first five pictures show the tying of the square bow. Notice as the first step that the strings are tied exactly like the first half of the square knot, which has been already described. Then the string from the left side is doubled up to form a loop or bight, and the right hand string also doubled up in the form of a loop, is wound around it as shown in Fig. 3 and poked through with the finger as shown in Fig. 4. When these loops are pulled up tight we have a square bow which stands crosswise of the shoes and which looks much better than the granny bow shown in the next series of pictures. The granny bow, like the ordinary granny knot, comes untied much more easily than the square knot. The square bow in the ordinary string will usually stay tied without trouble. Sometimes, however, in the case of a rather new, stiff string, especially a silk tie, it may come loose. To remedy this, what is known as the safety bow is tied. The first part of the process of tying the safety bow is exactly the same as the tying of the square bow up to the point where the loop or bight of the right hand string A is placed around the loop of the left hand string B. (See Fig. 10.) Instead if simply putting A around B as in the square bow, give the bight B a turn at the same time around A as shown in Figure 11. This makes a double loop around each bight as shown in Fig. 12. This knot can be pulled open the same as an ordinary bow but requires a much stronger pull and is very unlikely ever to become untied of itself.



Whipping the End of a Rope

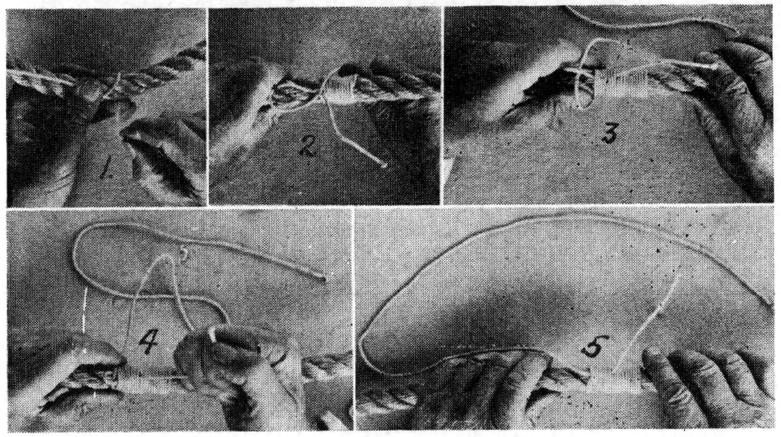
To keep the end of a rope from unraveling, sailors put on what they call a whipping. One of the best and simplest and quickest ways of doing this is shown herewith. A piece of string or twine something like 15 inches long is taken and one end placed so as to extend out beyond the end of the rope about two inches. The other end of the cord is then set against it so as to point in the opposite way, that is the long way of the rope. This is shown in Fig. 1. Next the part of the loop of cord shown in the right



hand of operator is wound around the rope and the other end of the string as shown in Fig. 2. In doing this care must be taken to keep the cord pulled very tight and each time it is wrapped around the rope it should lie against the former turn so as to make a smooth band of cord around the rope. This is shown in Fig. 3. The rule is to make the width of the whipping the same as the diameter of the rope. You will notice in Fig. 3 that this has been done and that the loop in the string is almost entirely used up. Next the operator holds the last winding of the string with his left thumb and pulls on the end which was left sticking out from the rope, so as to pull what is left of the loop out under the whipping. If the winding has been done so that the whipping is very tight and solid it will take a strong pull to pull the cord tight and it will need no further fastening, simply cut the ends off as shown in the last figure and the whipping will probably last as long as the rope.

It is often necessary to put a whipping or wrapping around a rope or other object where the above method could not be used on account of the wrapping being so far from the end. In such a case the cuts shown herewith illustrate a good way to perform this operation. A few inches of one end of the wrapping cord is left extending out to the left of where the

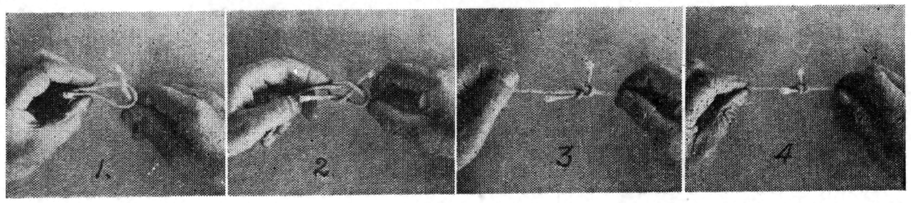
whipping should be and the winding begun as shown in Fig. 1. The winding or whipping is then continued until near the place where you want to stop,



when the end first spoken of is doubled back to form a loop as shown in 2. After a few more turns the wrapping cord is put through the loop. The loop is then pulled as shown in 3 and 4 until it is hidden under the last part of the whipping. This is shown plainly in Fig. 5. This method is often used in mending a cracked hammer handle or like tool, or a split fishing rod.

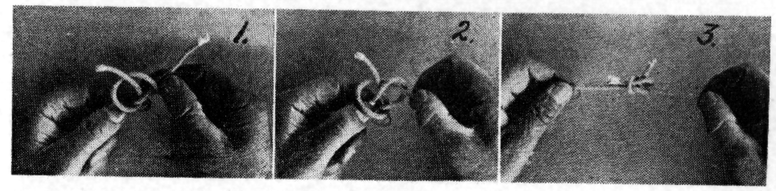
The Weaver's Knot

The weaver's knot, or as the sailors call it, the sheet bend, is a very useful and safe knot for tying two ropes, straps or strings together and when tied the way the weavers tie it, may be tied in less time than any other knot used for this particular purpose. There is a right and wrong way of tying it, and if a person attempts to learn to tie the knot from simply



Left Handed Sheet Bend

seeing the picture of it he is just as apt to get it wrong as right. In the series of pictures shown above, the knot is tied as I have seen numbers of boy scouts tie it by first forming a loop as shown in Fig. 1, then putting the other end through the loop and around and under itself as shown in Fig. 2. If the person doing this puts the rope around in the right way he will have a sheet bend. If he puts it around the wrong way, as shown in Fig. 2, he will have what sailors call a left handed sheet bend which will slip and stretch out some distance before it nips and in the case of a slippery rope, will come entirely apart. If the person tying this had put the second end around the opposite way or if he had tied it as the weavers tie it, he would have a knot which would hold without slipping and which would be a true weaver's knot. The right way to tie it is shown in the next series of pictures. To tie it as the weavers tie it, the ends of the

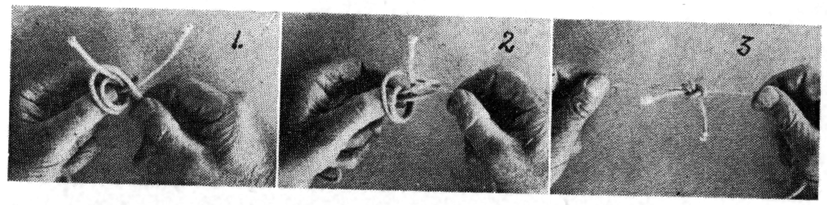


Tied by Weaver's Method

strings are crossed with the left hand end over the right hand one, and held with the left thumb. The standing part of the right hand rope is then turned around its own end as shown in Fig. 1, then the left hand end is laid down over this part and through the loop as shown in Fig. 2, where it is grasped by the left thumb and fingers against its own standing part. Now the standing part of the right hand rope is pulled out straight as shown in Fig. 3 and we have the weaver's knot with both ends on the same side. Notice that the knot which slipped (the left-handed sheep bend) was tied so that the ends were on opposite sides of the knot.

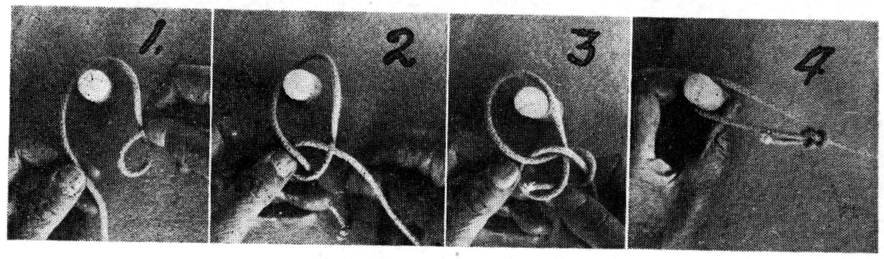
The Double Sheet Bend or Double Weaver's Knot

Sometimes when it is necessary to join two very slippery ropes, what is known as the double sheet bend is used. This is like the ordinary sheet bend excepting that the right hand standing part of the rope is wound first around both ends and then around its own end before bending the left hand end down across it. This is shown very plainly in the accompanying pictures and needs no further explanation.

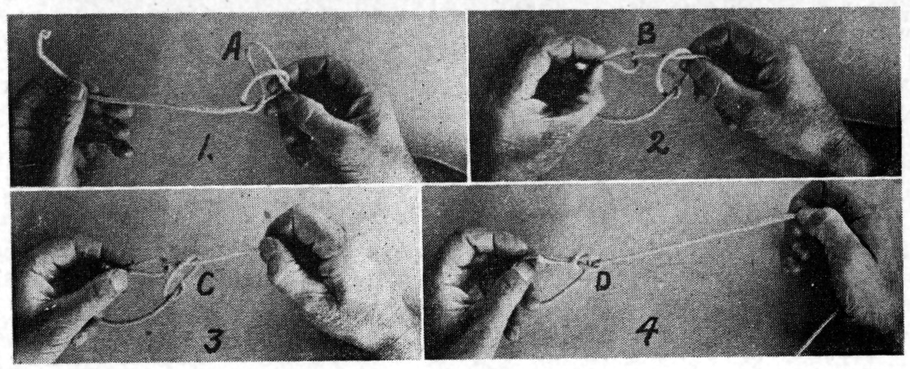


Double Weaver's Knot

The Bowline Knot



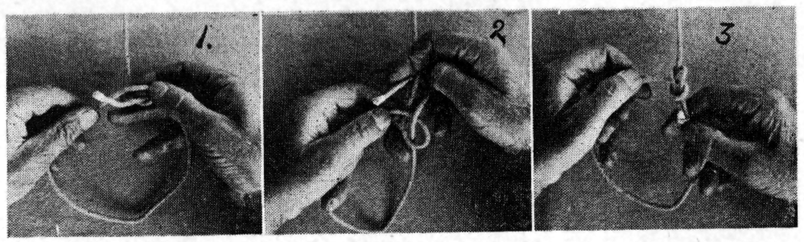
One of the most useful of all knots is the bowline knot. It is easily tied, does not slip either way and can always be easily untied after being pulled upon, or, as the sailors say, it does not jam. There are several ways of tying this knot, three of which are here shown. In the first method shown in the figure above, one end of the rope is put around some object, an over hand loop or turn is made in the standing part of the rope, the end is put down through this loop as in Fig. 2 and around the standing part and back through the loop as in Fig. 3. Fig. 4 shows the completed



Bowline—Cowboy Method

knot. The second method, known in some parts of the country as the cowboy method, is shown herewith. This is more or less of a trick knot but is useful in some situations. What is known as a Marlin spike hitch or boat knot is made in the standing part of the rope as shown in A in Fig. 2. The end in the left hand is then put through this loop and bent back on itself as shown at B in Fig. 2. When the standing part of the rope is pulled upon, this second loop is pulled through the loop of the boat knot with the result shown in Fig. 4. This method of tying the knot is convenient to use when tying an animal with a rope. The boat knot may be formed before the end is put around the animal's neck and the knot can be tied a little quicker than the first method described.

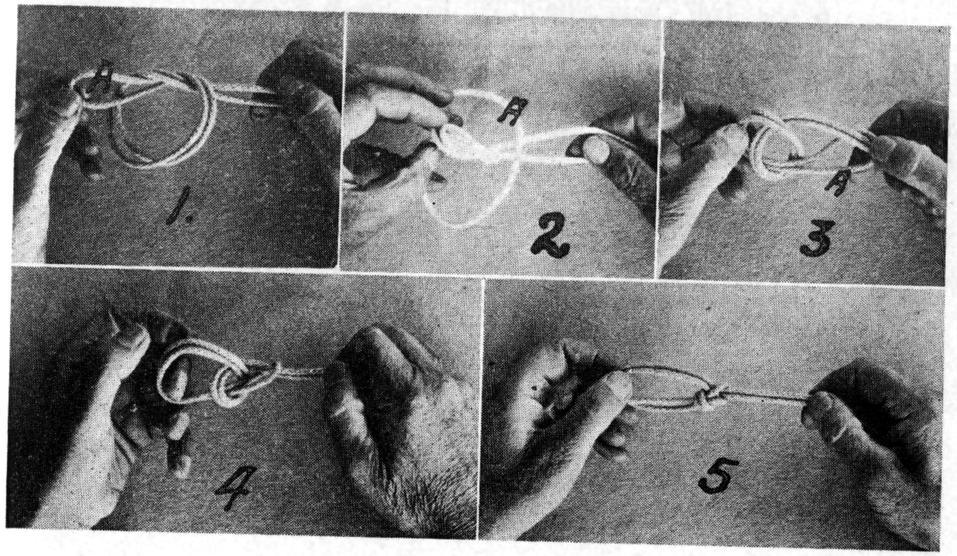
Bowline Loop



When it is desirable to form a loop in the end of the rope, the method of tying the bowline as herewith shown is used. The end of the rope taken in the right hand is placed across the standing part where the bowline is to be tied and a loop turned in the standing part around the end as shown in Fig. 2. The end is then carried around the standing part and back through the loop as shown in Figs. 2 and 3.

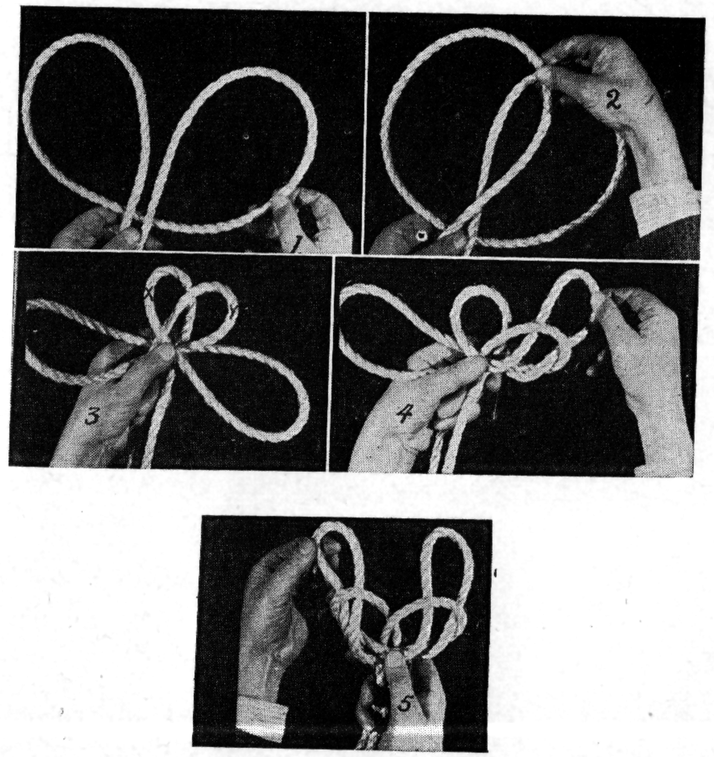
Bowline on a Bight

What is known as the bowline on the bight or double bowline, is shown herewith. The process of tying it consists first in making a loose overhand knot with a bight of the rope as shown in Fig. 1, then turning the bight back over the overhand knot as shown in Figs. 2 and 3. The two ropes forming the bight are then grasped just behind the overhand knot as shown in Fig. 3 and the knot pulled tight as in Figs. 4 and 5. This knot is often used where it is necessary to hitch a team to a rope at any other point than at the end.



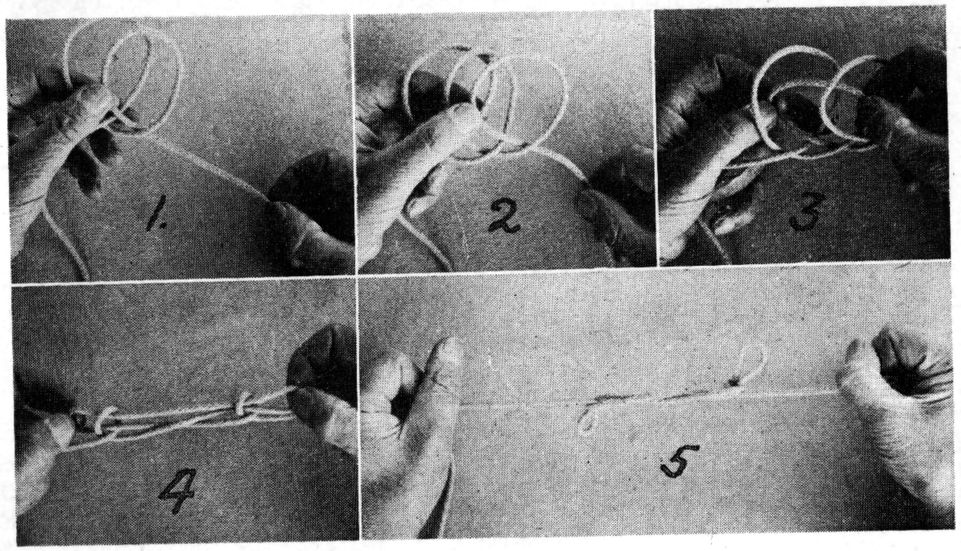
Spanish Bowline

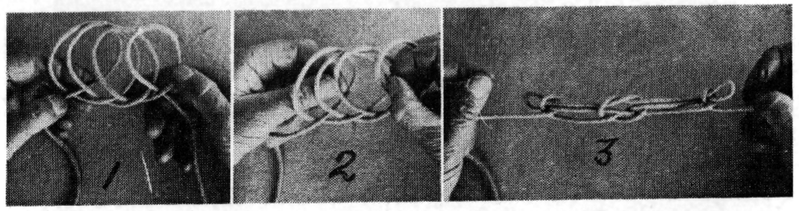
The Spanish bowline is used where two loops of equal size are desired. It is made by looping a bight of rope as shown in Fig. 1, then crossing the inside edges of the two loops as in Fig. 2, then bending the loops back so as to form the two smaller loops marked X and Y in Fig. 3. The two outside loops are then put through the smaller ones as shown, and the knot is formed.

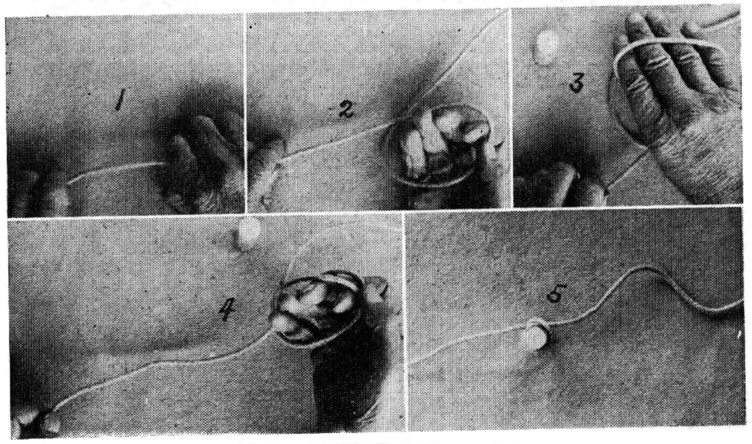


The Clove Hitch and the Sheep Shank

What is known to sailors as the clove hitch is simply two half hitches or loops made in the same way and one placed upon the other. In the picture below which illustrates the making of the sheep shank, the first cut shows a clove hitch. Fig. 2 shows one more underhand loop made and laid on the other two and Fig. 3 shows how the operator reaches through the upper

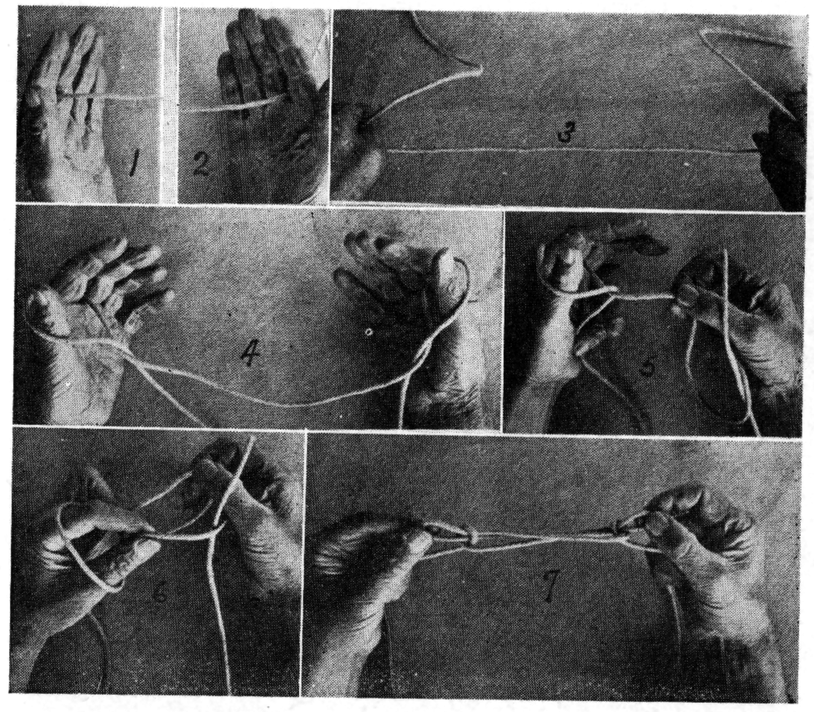




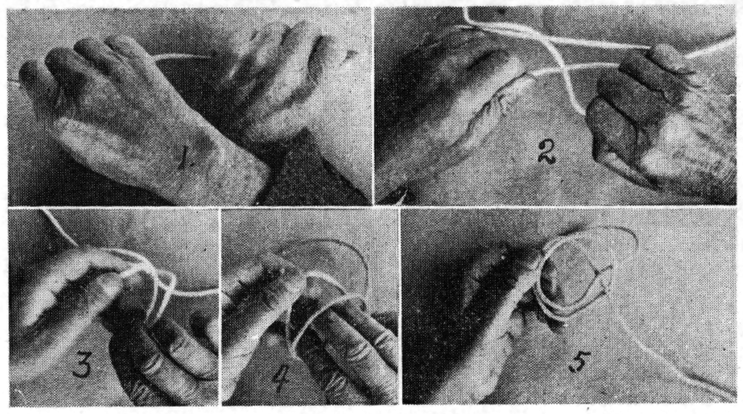


loop with his right hand and through the lower one with his left hand and takes hold of each side of the middle loop. When these are pulled out as in Fig. 4 the sheep shank is formed. Another fancy sheep shank is made by the same process only four loops are used instead of three and the operator, after making the four loops, reaches through the first two from each side and takes hold of the third loop. When these loops are pulled out we have the sheep shank with the fancy center as shown in Fig. 3.

There is a way of picking up a clove hitch with one hand which is illustrated in the following cut. The rope is first grasped with the right hand with palm down as in Fig. 1. The hand is then turned up as shown in Fig. 2 which shows a loop around all the fingers. The hand is then carried a little way to the right and the rope again picked up in exactly the same manner as at first as shown in Fig. 3. The result will be a clove hitch as shown at Fig. 4.

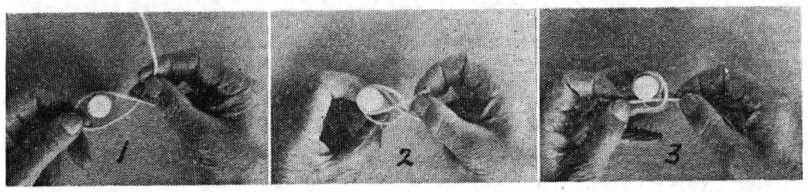


Another trick method of making the sheep shank is shown in the following cuts. The rope is held in the two hands as shown in Figs. 1 and 2. Notice that the rope is held between the first and second fingers of each hand. The hands are then turned down and brought up in such a way that the ends lie across the main part of the rope and the thumb and forefinger of each hand are enclosed in a loop. (See Figs. 3 and 4.) Fig. 5 shows how the rope near the left hand is picked up by the right thumb and forefinger. Fig. 6 shows the left thumb and forefinger doing the same thing with a loop of the rope near the right hand. These two loops are then pulled through as shown in Fig. 7 and the ends are pulled up snug, forming the sheepshank.



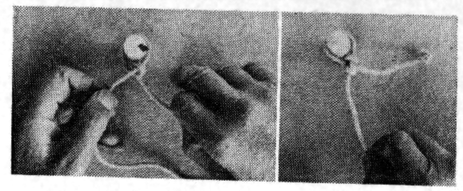
A quicker way of forming the clove hitch, and one which is often used in heavy rope is here shown. The hands are crossed, palms down, as shown in Fig. 1 before the rope is grasped. Then after grasping the rope the hands are drawn past each other as in Fig. 2, then, without turning either hand, carry the left hand over the right, and grasp both loops with the left hand. These loops will be found to form a clove hitch.

The clove hitch as formed in either of the above ways, may be used wherever it is possible to put the hitch over the top of a post or stake, but when it is necessary to use the clove hitch around a telephone pole or in any such situation, it is necessary to learn to tie it in another way. The following three cuts show how the hitch may be made in such a place. The end of the rope is put around the post and passed under the standing part as shown in Fig. 1. It is again carried around the post in the same direction above the first turn and under itself as shown in Fig. 2. These two turns or hitches form the clove hitch.

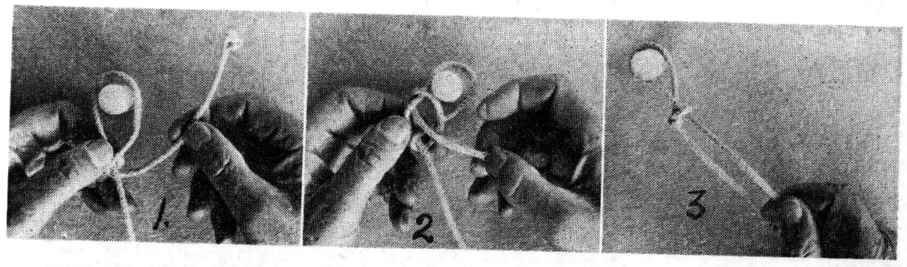


Two Half Hitches

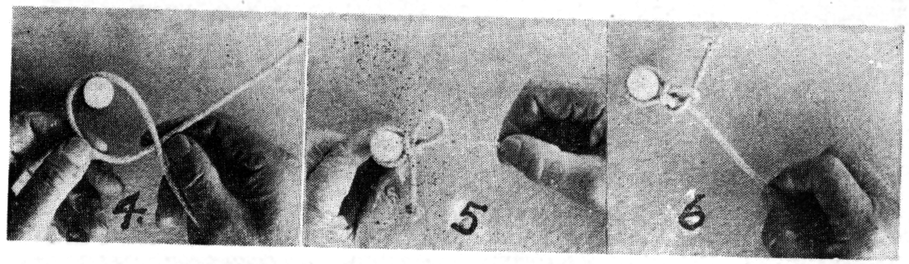
Using two half hitches is a method often employed in tying up a boat, or tying a clothes line to a post. It is such a simple process that very little explanation is needed of the two pictures shown herewith. When putting the rope around the post the end is placed once around the standing part next to the post and then again in the same direction around the standing



part. In other words, a clove hitch is formed around the standing part of the rope. If this process be reversed, that is, if the final wrapping of the end around the standing part is done toward the post, we will have what sailors call a buntline hitch, which when pulled up tight will not come loose of itself and cannot be easily shaken loose. In making this knot the standing part of the rope is held taut or straight while the end is being put around. If,

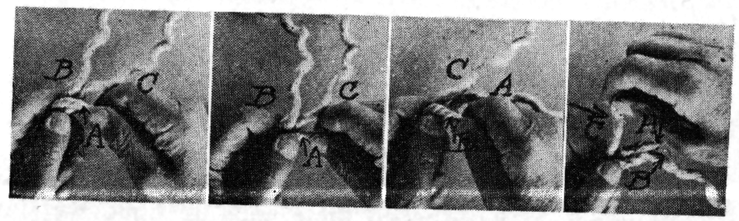


however, the same knot is tied while the standing part is loose and the end is pulled up tight, we will have a knot like in Fig. 3 which will not slip like an ordinary halter knot and in some situations is much better than the common halter knot. The Figs. 4, 5 and 6 show the different steps used in tying the ordinary halter slip knot, which when finished, will slide or slip and is usually tightened up against the post and the end put through the loop making a sort of safety knot.



Relaying an End of Raveled Rope

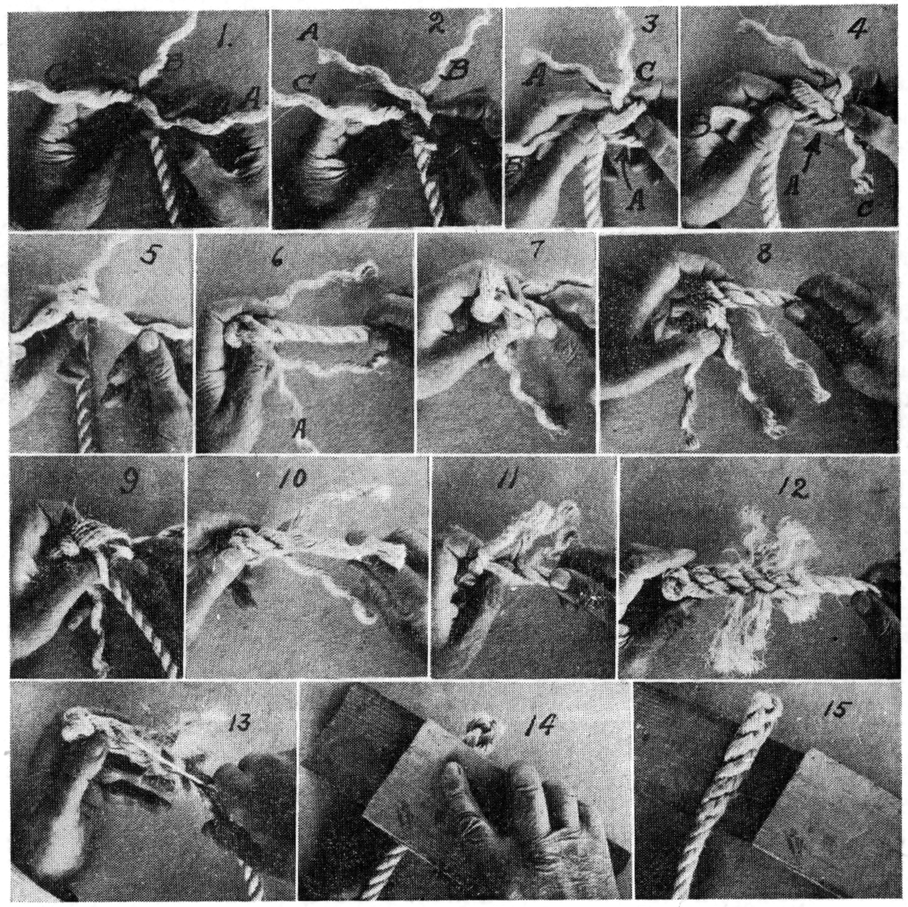
The picture shown here illustrates the relaying of strands where a rope has become unlaid or unraveled. Each strand may be laid back in the place where it came from so that the rope is as good as new when the proper method is followed. The rope should be held in the left hand as shown in



the first figure and the first strand (marked A in the first picture) is twisted hard with the right hand and laid down across the rope to the right and the left thumb placed on it to keep it from untwisting. Then the next strand to the left (marked B in the cut) is twisted and laid down in the same manner. During the process the rope is not turned around at all but the left thumb is pushed straight up each time to hold the strand which is twisted and laid down. This is a process which is a little difficult to explain without having the actual rope as an illustration, but this particular set of pictures has been tried out on a beginner who seemed to have no trouble in carrying out the directions.

Spliced End

What is known to sailors as a back splice or spliced end makes a nice finish for the end of a halter rope, a child's jumping rope, or any other rope where it is not desirable to have an ordinary knot at the end. The picture herewith shows the different steps in making the spliced end. The end of



the rope should first be unlaid about four or five complete turns of the rope. The end of one strand (marked A in the picture) is laid over between strands C and B in such a way that a loop is left in strand A. Strand B is then laid down over strand A so as to lie between the loop of strand A and the end of strand C. The end of strand C is then brought down over strand B and through the loop of strand A as shown in the cut where the arrowhead is pointing. Having pulled these ends up tight, we should have

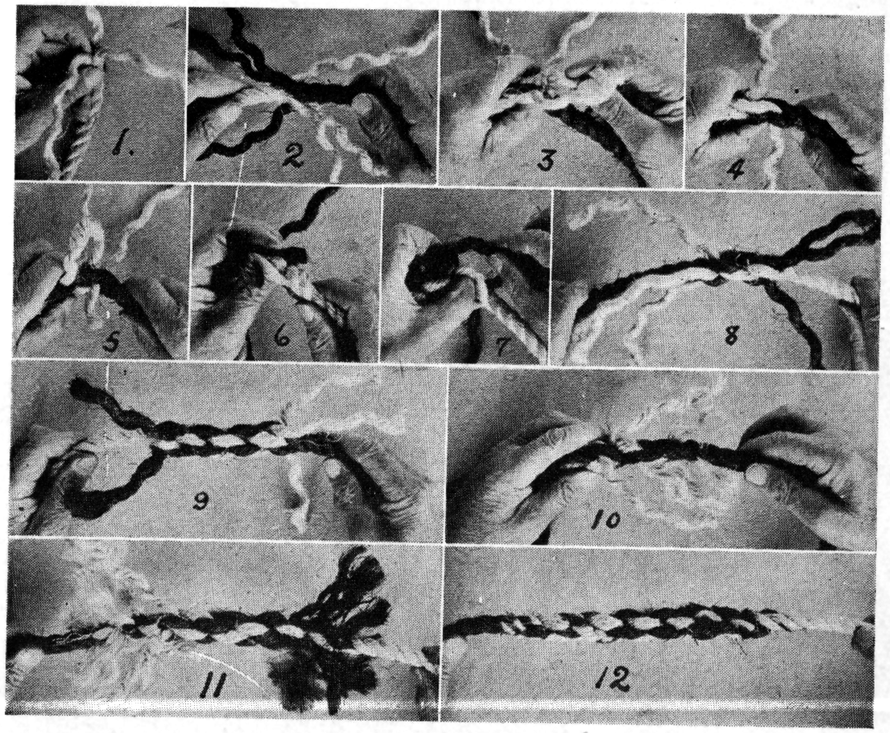
what is known to the sailors as the crown, which is shown in the fifth picture. The succeeding pictures show the process of splicing the ends back on the rope from the crown. In performing this operation each strand end is placed around the strand in the solid rope which lies next to it. An easy way to do this is for the operator to hold the crown in his left hand as shown in Fig. 6 and by untwisting the rope a little slide the left thumb under the strand as shown. The loose strand which is shown at A in the cut is then placed against the end of the thumb and drawn under strand B and drawn down tightly.

This is quite plainly shown in cuts 7 and 8. To help in making a smooth splice a little trick is shown in Fig. 9 which consists in slightly untwisting the strand end which is being placed around the other strand so that it will lie flat much like a strap and will not leave so large a bunch as it would were it not untwisted.

After putting each strand end around the strand of the rope which lies next back of it as described in the last paragraph, and pulling all the ends tight, we should have something which looks like the picture No. 10. The same process is again repeated with all three strands, then a part of each strand end is left out and the balance of the strand carried around in the same way as before, producing something which looks like Fig. 12. All of the extra fiber may now be trimmed off and the whole end rolled between two pieces of board as shown. Finally the end should look like that shown in the last cut.

The Short Splice

The short splice is a method of joining the ends of ropes by a process which takes very little time and leaves the rope considerably larger than the original, in fact, the middle of a short splice contains twice as much material as the original rope. The beginner should learn to make the short splice before attempting the long splice and the pictures shown herewith illustrate fairly well how the work is done. The first thing to do is to

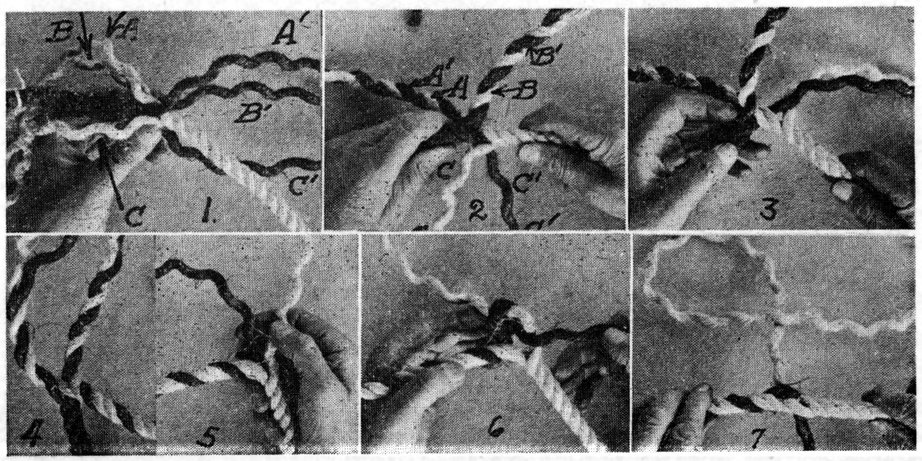


unlay the ends to be spliced about five or six turns of each rope end being sure that the ends are opened up as shown in Fig. 1 so that no strand is left crossing over the middle. If a strand should be left over the middle the splice will be spoiled, so this is an important matter to be attended to. Having both ends properly opened up, the next step is to set them together in such a way that each strand lies between two strands from the opposite rope. This is shown quite plainly in Fig. 2. The next step is for the operator to grasp the left hand rope together with the strands from the right hand rope with his left hand and hold them all together while he starts the splicing by pushing his thumb under the first strand from the right hand rope. The strand from the left hand is then placed against the end of his thumb and pulled back through so that it lies around the strand from the other rope. This is shown plainly in Fig. 4 where the end of the white strand has been placed around the strand of the black rope. The rope is now turned toward the operator and the same process exactly is repeated with the next pair of strands; that is, the one from the left hand is placed around the black strand from the right hand rope and pulled under toward the operator. After all three of the white strands have been placed once around the black strands the operator lets go of his hold on the left hand rope and reverses the rope so as to place the black ends around the white strands in the same manner as above described. When this has been done the result should look like Fig. 8. When the process has been repeated once more it should look like Fig. 9. From this point on, the same process is repeated with the difference that a few fibers from each strand are left out each time so as to finish or taper off as shown in Figs. 10 and 11. All protruding ends are then trimmed off and the splice should look like the last picture. If the operator will then take this splice and untwist it a little, he will see that it is a perfect three-strand rope with strands in the middle containing twice as much material as the original rope.

The author is well aware that many sailors make the short splice in a different manner. Instead of putting each strand around and around its mate as described above, they weave each strand first over one strand and under the next in the manner of a basket weave, until the ends are used up. This does not make so smooth a splice and is much harder to do. The method described above makes a splice which is stronger than the original rope.

The Long Splice

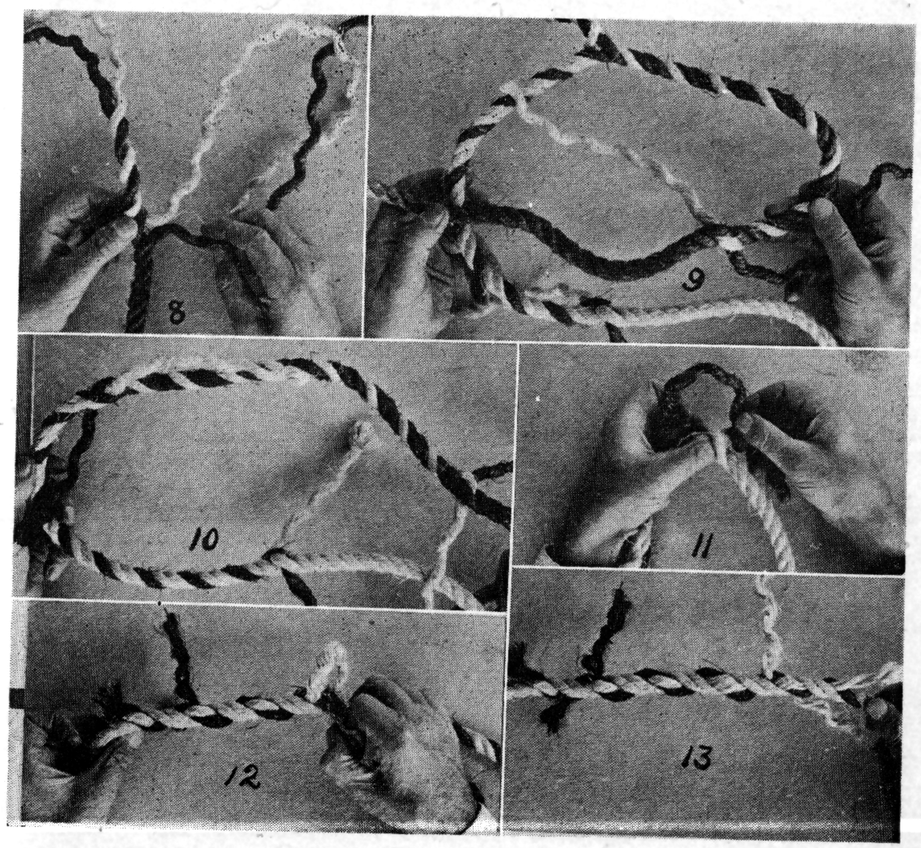
What is known as the long splice is a method of mending a broken rope or of joining different ropes together so that the result leaves the



spliced part about the same size as the original rope. If properly made, the long splice should be about as strong as any other part of the rope. The rule in making the long splice is to unlay each end for a distance of about fifty times the diameter of the rope itself. After doing this unlaying and making sure that no strand is left crossed over the middle, the ends are placed together in exactly the same manner as in the short splice. Then strands from opposite ropes are twisted together in pairs so as to hold the middle of the proposed splice in place.

The method of twisting these strands together is shown in Cuts 1 and 2. It should be noticed that each strand from the left hand or black rope is twisted together with the strand from the white rope which lies back of it. In Figs. 1 and 2 the strands marked A and **A** are shown twisted together and also B and **B.** Only two pairs of strands are thus twisted together. Then the splicing is begun as shown in Figures 3, 4 and 5 by unlaying the remaining white strand and twisting the black strand in its place. It is a good plan to unlay only one turn of the right hand rope at a time, otherwise the rope—especially if it be a hard twisted rope—will tend to close up and it will be hard to get the strand from the left hand rope to lie snugly in place. This left hand strand must be twisted hard and pulled down into place so that it will exactly fit into the place vacated by the white strand.

This same process is carried out until about three-fourths of the left hand strand has been twisted into the rope. Then this strand is tied around the white strand as shown in Fig. 6 in exactly the same manner that the first half of a square knot is made. This is shown completed in Fig. 7.

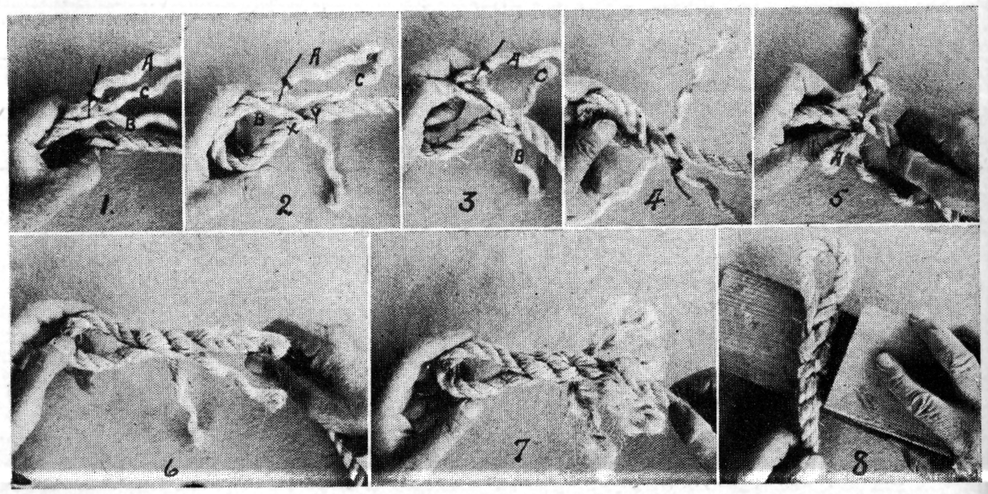


We now go back to the middle of the rope and taking either one of the other pairs of strands and taking out the twist which we put in at the start, we will splice the white strand in the place of the black one going the opposite way from the middle that we did at first. After carrying this out the same distance as the first pair of strands and tying the two strands together in the same manner, we will have something which looks like Fig. 9. The two strands remaining in the middle of the splice are now tied together with the first half of the square knot the same as the others. Our splice will then look like Fig. 10. All three pairs of strands are now to be finished in the same manner. Fig. 11 shows how this finishing process is begun. It consists simply in putting the black strand around and around the other strand. The easy way to this is to untwist the rope enough so that the left thumb may be slid under the white strand. The end of the black strand is then placed against the end of the thumb and pushed back through around the white strand. Both strands should then be pulled tight and the process repeated. After two or three turns it is customary to leave out a little of each strand each time it is put around its mate so as to make a neat taper in this part of the splice. After this end of the strand is all used up the rope is reversed and the white strand is put around its black mate and finished off in the same manner. Fig. 12 shows this process nearly completed and Fig. 13 shows one pair of ends completed but not trimmed off. After all three pairs of ends are finished in this manner, the loose ends may be trimmed off, and if the work has been well done the rope will be only very slightly larger in the three places where the ends were finished than at any part of the rope. If the splice has been well made this should be the strongest part of the rope.

There is a way of making a long splice so as not to increase the size of the rope at the splice and this is sometimes necessary in the case of rope belts on machinery which have to run at a high speed. This way of splicing the rope, however, takes away about one-sixth of its original strength and is not to be recommended except in cases like the one above mentioned.

The Spliced Eye

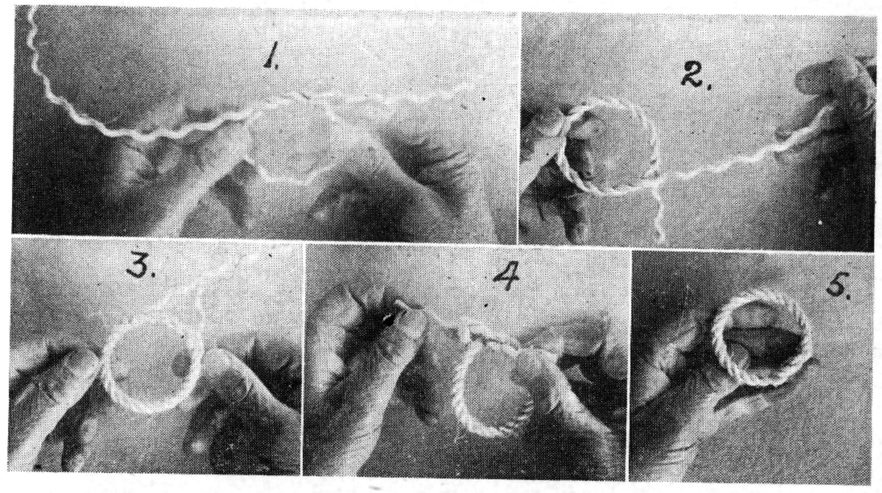
It is often desirable to splice an eye in the end of a rope. One of the best ways of doing this is illustrated herewith. The end of the rope is first unlaid about four turns and two strands marked B and C are put through the rope in the following manner: The rope is untwisted enough so that the thumb and first two fingers of the left hand, shown in Fig. 1, can



separate the strands somewhat. Strand B is then put around one strand of the main rope as shown in Fig. 2. This strand is marked X. Strand C is started into the same opening through which B was put but is pulled out the other side of the rope. In other words, C is put under the next strand marked Y. This is shown quite clearly in Fig. 3. All of the strands should now be pulled down tight as in Fig. 4. From this point on, the process of finishing the eye splice is exactly the same as the case of the back splice or end splice already described.

A Grommet

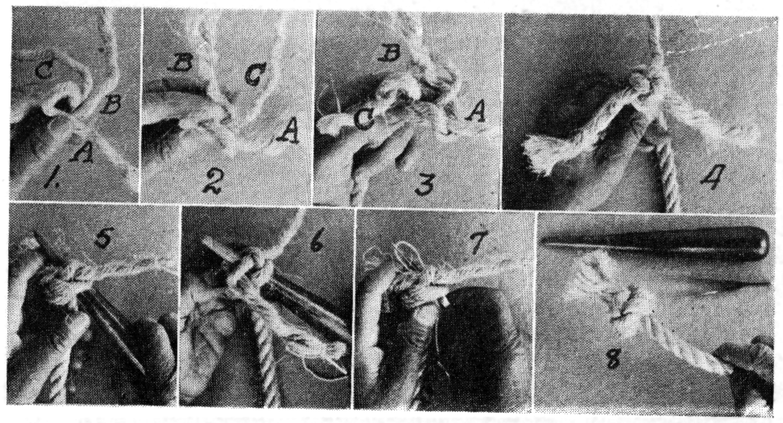
A grommet is simply a ring of three strands made from a single strand of a rope. To make one of a given size, one should start with a length of strand about four times the circumference of the desired grommet. The



pictures herewith show very clearly how the grommet is made by simply starting in the middle of the strand and twisting one part around the other and continuing the process until a three-strand ring is completed. The finish where the ends come together is the same as the finishing of the strand in the long splice.

The Wall Knot and Its Relatives

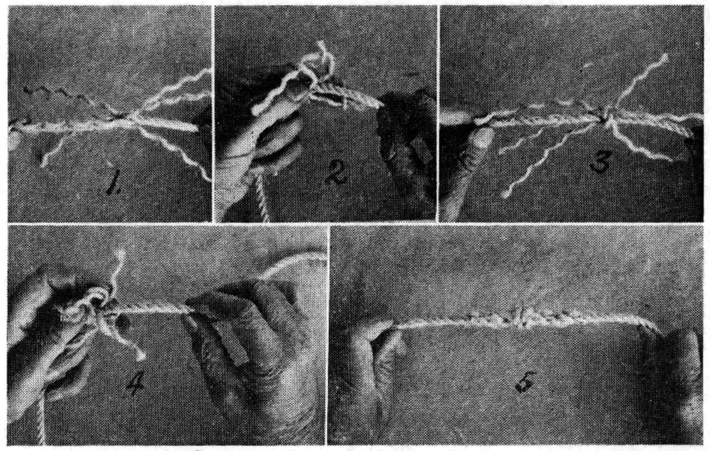
The wall knot, the single Matthew Walker knot and the double Matthew Walker are closely related. The wall knot, which is made by passing each strand of the rope through a loop in the strand next to it, is



the smallest of these three round knots. The picture herewith shown gives a good idea of how it is made. The rope is first unlaid three or four turns and one strand marked A in Fig. 1 is laid down against the rope and held with the left thumb so as to leave a loop in it. Strand B is then brought around the end of Strand A and held behind the rope with the first and second fingers of the left hand. Strand C is then turned around the end of Strand B and put through the loop of Strand A. This is all plainly shown in Figs. 2 and 3. The strands are then pulled down tight with the result shown in Fig. 4. The wall knot if left without any other way of finishing it is very apt to become loose. What is known as a man-rope knot is made from the wall knot by taking each strand end around the strand next to it going in the direction of the lay of the rope and brought out through the middle of the wall knot as shown by the position of the Marlin spike in Figs. 5 and 6. In Figs. 6 and 7 a method of putting these strands through the knot is shown. A piece of strong twine is tied around the end of the strand to keep it from unraveling and then is pushed up through the knot with a pair of tweezers and the strand pulled up after it. The finished man-rope knot is shown in Fig. 8 together with a picture of the Marlin spike and the tweezers.

The Shroud Knot

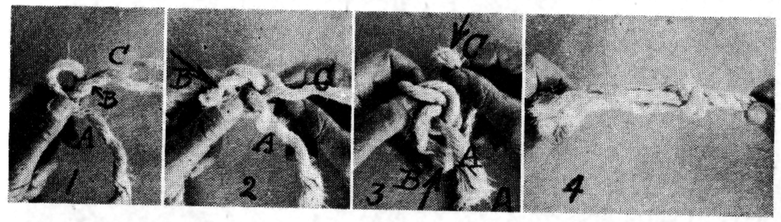
One use which is sometimes made of the wall knot is to make an emergency splice in a rope. In doing this the rope ends are unlaid about three or four turns and set together exactly the same as for making a short



splice. This is shown in Fig. 1. The strands from the right hand rope together with the left hand rope are grasped with the left hand and a wall knot is formed around the right hand rope by the strands from the left hand rope. The work is then reversed and the same thing done with the strands from the opposite rope. We will then have a pair of wall knots with their backs together. The ends of the strands are usually tucked under the strands of the rope as shown in Fig. 5. This however is not necessary insofar as the strength of the splice is concerned. This way of joining two ropes does not weaken the rope as much as most any other knot would, and after being used can easily be taken apart with no waste. This manner of joining two ropes is called by sailors the shroud knot.

Single Matthew Walker Knot

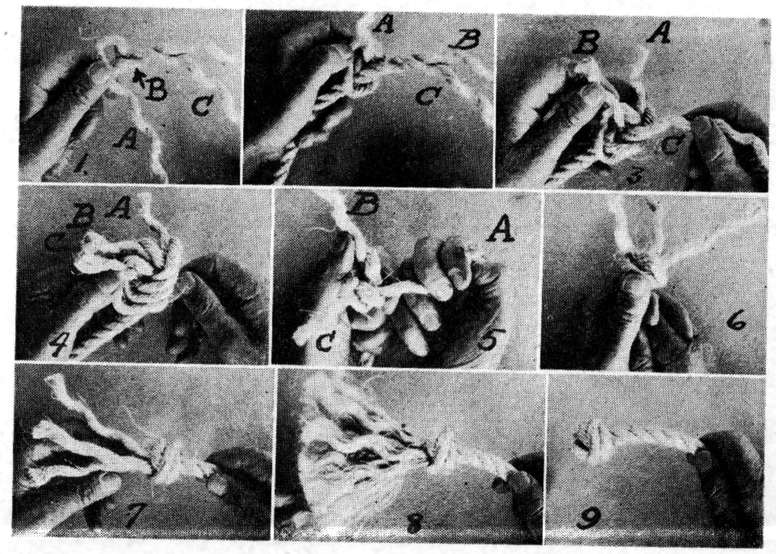
The round end knot, known as the single Matthew Walker, is similar to the wall knot and one size larger. While the wall knot is made by putting each strand around the strand next to it, the single Matthew Walker is made by putting each strand around the second strand from it. The accompanying pictures show the method. First, the strand marked A in the picture is laid down against the rope the same as at the start of the wall knot. The second strand marked B in the picture is then carried down around the end of strand A and around the rope and through the loop of Strand A. Strand C is then carried around the ends of both B and C and brought up through the loops of both B and C. This may seem a little



confusing but if the figures and arrows shown in the cuts 1, 2 and 3 are followed, a little practice will enable one to tie this knot very readily. It makes a very nice knot when pulled down tightly and one which will not come undone of itself.

The Double Matthew Walker Knot

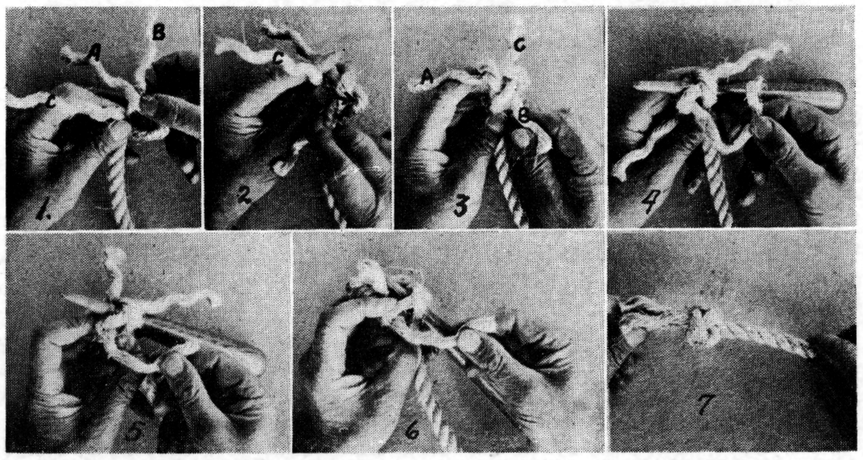
The double Matthew Walker is another of the round end knots and is one size larger than the single Matthew Walker. It is made by first passing strand A in Fig. 1 around the rope and through its own loop as shown in Fig. 2. The end is held up out of the way so that it will not get confused with the others and the next strand or strand B is laid down to form a loop and carried around the rope and through both the loop of A and its own loop. Strand C is then laid down in the same manner, carried around the rope and put through the loops of A, B and its own loop. This is shown plainly in Figs. 3 and 4. Now if all the strands are pulled so as to tighten the knot and then the knot rolled toward the ends of the strand with the thumb as shown in Fig. 6, a perfect round smooth knot will be produced



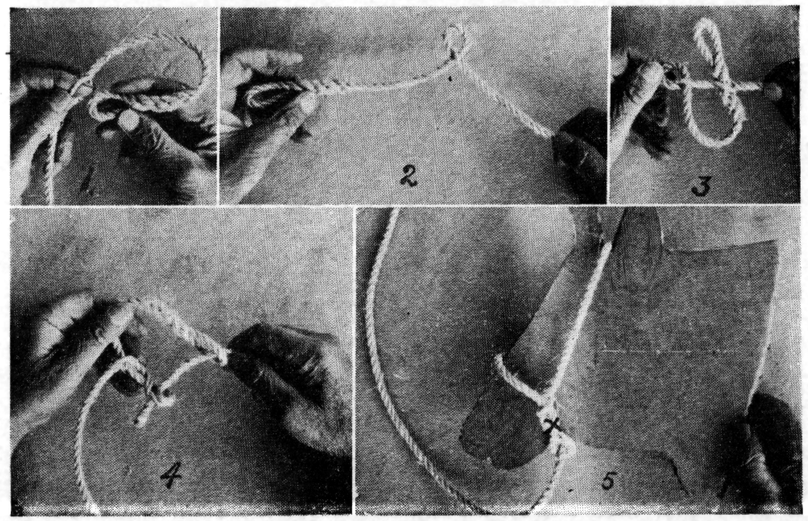
as shown in Fig. 7. To produce the right result it is necessary to pull the strands down in the right way. Strand A is first pulled, not endwise of the rope, but at right angles to it, until the slack is taken out of it. Then the same thing is done with the other two strands. If the first strand is pulled too tight at first it will be difficult to tighten the others; so the best way is to pull gently at first and then go around the rope pulling each strand a little tighter each time until the knot is made very solid. Then roll it down as mentioned above so that the strands all appear to come out of the middle of the knot. If you wish to have a tassel on the rope simply comb out the ends of the strands and the result will be like Fig. 8. If a plain round end is wanted instead of a tassel, it is safe to cut the strands off quite close to the knot as shown in Fig.9.

Round End Knot

Another way to form a neat, round knot in a rope end is shown herewith. First, a crown is formed the same as in the beginning of the end splice. See Figs. 1, 2 and 3. The end of each strand is then put around the



strand next to it, as shown by the position of the Marlin spike in Fig. 4, and pulled up through the middle of the knot. When pulled up snug it makes a symmetrical, round knot which will keep its shape.

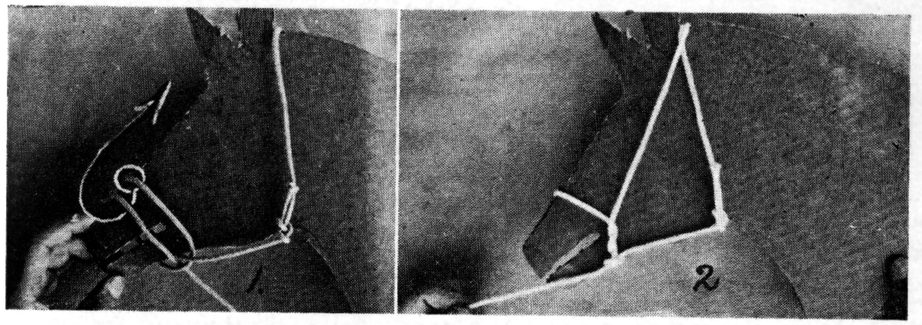


Lead Halter

A halter which may be adjusted to fit almost any size animal is made as shown in the above pictures. First, an end splice is made as has already been described; then something like eight or ten inches from this eye the rope is opened up and the eye pushed through and pulled along so as to form a loop as shown in Fig. 2. About two inches along on the main rope it is opened up again and the eye pushed through again. We now have a simple halter already made except assembling. This is done by putting the end of the rope first through the spliced eye that was first made, then through the other loop as shown in Fig. 4 and pulling it through far enough to leave a loop of the proper size to go over the animal's head. Fig. 5 shows how it is fitted to an animal. This sort of halter is handy to have in any stable because it may be easily fitted to a horse, cow or calf which is to be led about. To make it a little more permanent where it is to be left on the animal, after adjusting as shown in Fig. 5, the end of the rope is slipped under the part marked X and then down under itself next to the eye so as to form a sheet bend.

Hackamore Halter

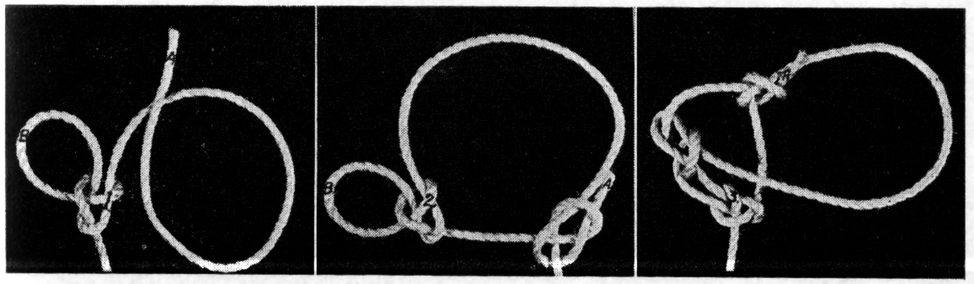
What is known to cowboys as the Hackamore halter is often made in an emergency and the trick of making it ought to be known by every boy or man who has to do with the handling of livestock. To make this halter the one end of the rope is placed around the animal's neck and tied with a bowline knot. Then two half hitches are taken around the animal's nose as shown in Fig. 1. The upper part of the hitch first made is then brought



down around the other part as shown by the arrow in the picture and enough slack is pulled out with it so as to make a loop large enough to go over the animal's head by the ears. The result is shown in Fig. 2.

Emergency Halter

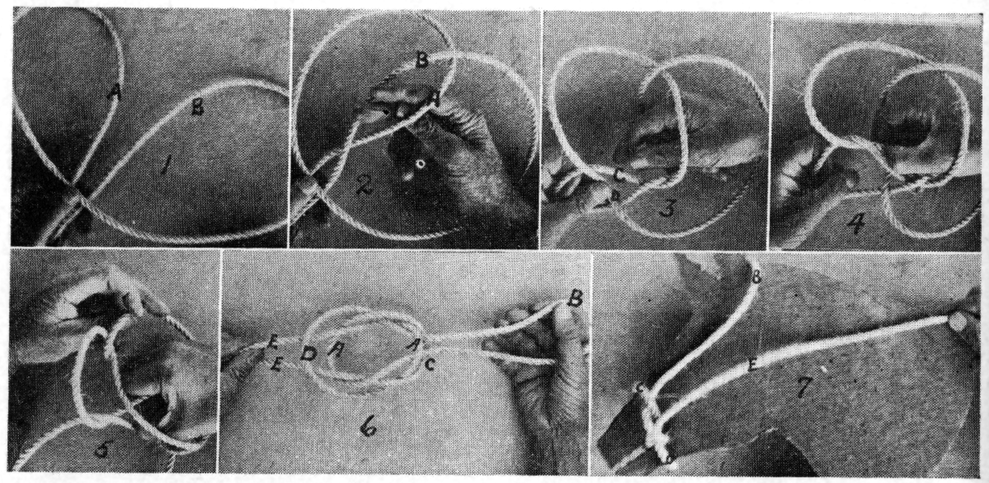
An emergency halter may be easily made from a piece of rope by simply tying two bowline knots. The accompanying cuts show how it is



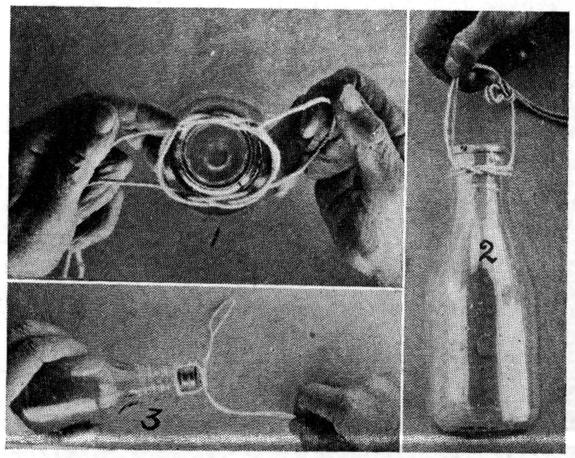
done. First, a bowline knot is formed as shown in Fig. 1, leaving the end A long enough to go over the animal's head, and the loop B something like six inches in diameter. Next make another bowline knot as shown in Fig. 2 at the right distance from the first one so that the part of the rope between them will be the proper length for the nose band. Now put the long end of the rope through the loop B and the halter is ready for use. After fitting to the head of the animal, the long end of the rope may be run through between the loop and the animal's jaw, and then under itself, forming a sheet bend, as shown in Fig. 3.

The Rope Bridle or Sailor's Jug Knot

What is known to sailors as the jug knot and to cowboys as the rope bridle, is made by forming a large loop in the middle of a rope and bending it back as shown in Fig. 1, so as to form the two loops as shown in Figs. A and B. Then the ropes are crossed as shown in Fig. 2 and the right hand



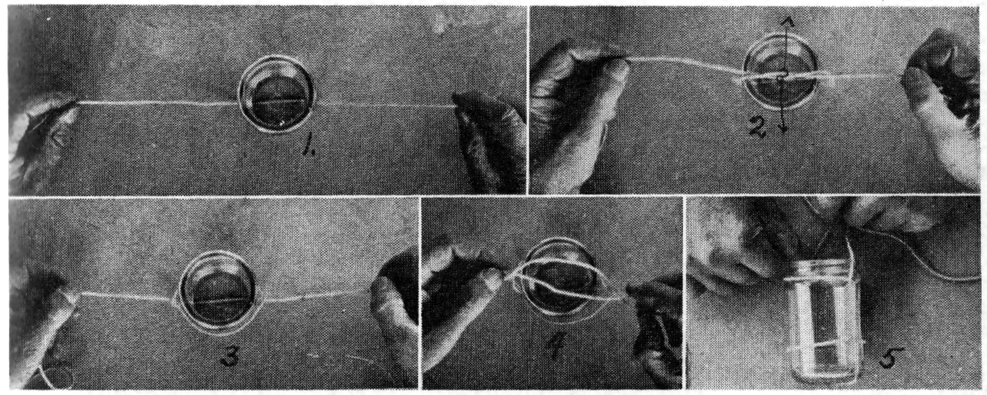
passed through under A and over B as shown, then around under C as in Fig. 3, grasping D and pulling it back through the loops as shown in Figs. 4 and 5. Fig. 6 shows the knot completed. If it is to be used as a bridle, the two parts marked A are drawn together in the middle and used for the bit of the bridle. These go in the horse's mouth, the loop C fits over his nose, the loop D under his lower jaw, and the loop B goes over his head



back of the ears. The ends EE are then used for the reins of the bridle. This bridle may be formed from a long rope in a fraction of a minute and may be easily adjusted to any size colt or horse. This same knot is used to form the handle for a fruit jar, milk bottle or any such object by simply tightening around the neck and tying the ends and loop B together to form a handle. This knot is also used to good advantage in tying a cork in a bottle. The knot is simply pulled tight around the neck of the bottle and the surgeon's knot is tied over the top of the cork as shown in the cut.

The Barrel Sling

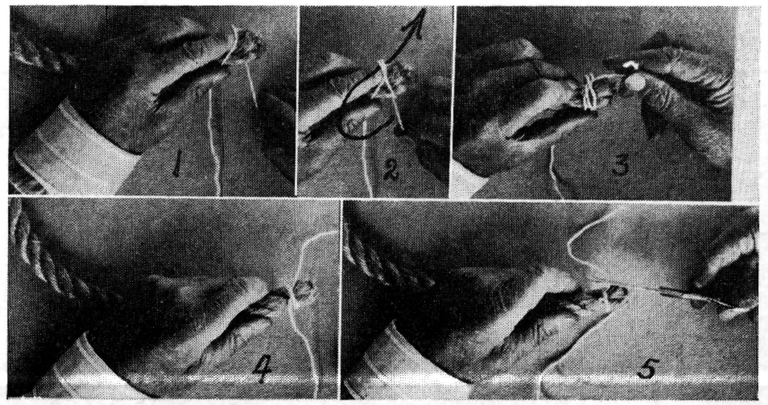
The accompanying picture shows how any round, smooth object may have a handle attached to it by which it may be carried. In Fig. 1 we have a long string upon the middle of which has been placed a fruit jar. The two ends were then brought together over the top of the jar and the first half of a square knot formed as shown in Fig. 2. Then the two parts of this half square knot were separated as shown by the arrows and carried down to near the bottom of the can on each side. Then the ends were



brought up over the top of the can again and this same act repeated. This gives us two hoops around the can which will not slip because the two strings are pulling in opposite directions and if the two ends are now tied together over the top of the can, we will have a good handle for carrying it.

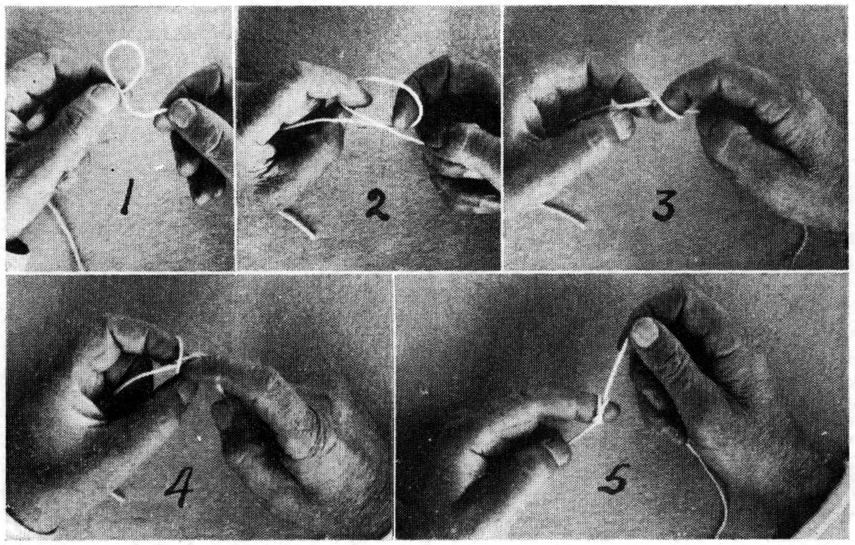
The Strangle Knot

The accompanying cut shows a quick method of securing the end of a rope so that it will not unravel. The knot used in doing this is one of the

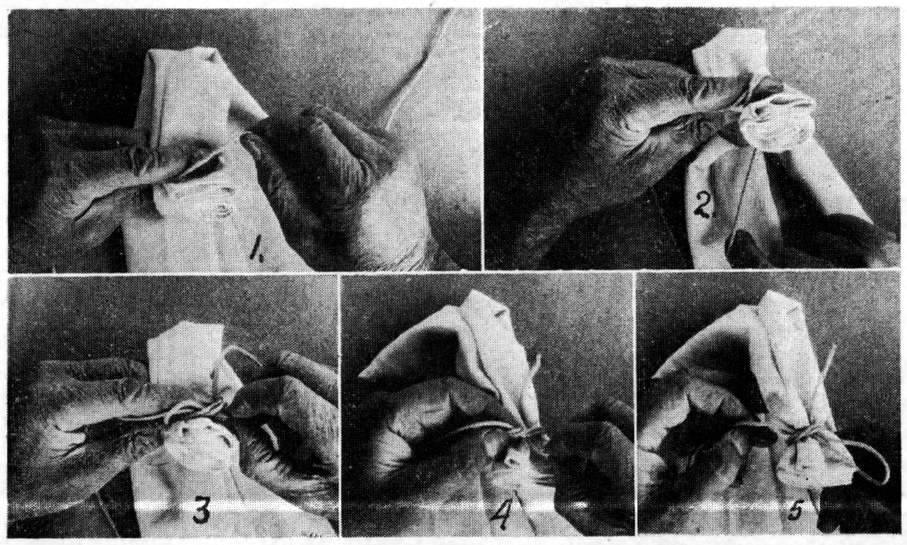


so-called strangle knots. It consists in simply winding the string twice around the object to be fastened, crossing the second turn over the first as shown in Fig. 2; then running the end through under both the turns of the rope as indicated by the arrow. The resulting knot is shown plainly in Fig. 3. As both ends of the string are pulled tight the knot as shown in Fig. 4 is the result. It is the same as the first half of the square knot with the one turn of the string riding over the middle.

Another form of the strangle knot is made where it is not possible to use the ends of the rope. That is, it may be anywhere in the middle of the rope without regard to the ends. To form it, make an overhand loop in the rope, place left forefinger pointing downward toward the loop, the right upward through the loop, then bring the ends of the two fingers together



and the result will be the same as the knot described above with the difference that the turn of the string which lies over the half square knot crosses it in the opposite direction. This is clearly shown in the picture.

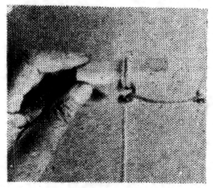


Strangle Knot Used as a Bag Tie

The form of strangle knot first described may be used to make a very effective tie for a duffle bag or a sack of grain. In the following cut Figs. 1 and 2 show how the cord is given two turns around the forefinger of the left hand and the mouth of the bag while the end of the cord is held by the other fingers of the left hand. A loop or bight of the right hand part of the cord is then put through under the two turns in the place of the left forefinger which is withdrawn at the same time. The loop and the left end are then pulled tight enough to take up all slack. This knot holds well but may be instantly untied by a strong pull on the end forming the loop.

The Fisherman's Bend or Anchor Knot

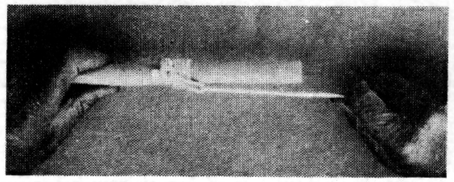
The fisherman's bend or anchor knot as the sailors call it because of the use they make of it, is made by putting the rope end twice around the object to which it is to be tied or twice through the ring of the anchor,



then around the standing part of the rope and through under both the wraps around the ring, then once more around the standing part. Sometimes in addition the end is whipped or served to the standing part with a smaller rope or cord.

The Lifting Hitch

What is know as the lifting hitch, sometimes spoken of as the well pipe hitch, is shown in the picture herewith. It is made by simply wrapping the end of the rope around the pipe or whatever object is to be lifted and a bowline loop made around the standing part as shown in the picture. When this is done and the standing part is pulled upon, the coils of the rope about the pipe are tightened so that it will not slip.



Two of these hitches around a flag pole or other smooth object which is to be climbed will enable a person to climb the object without using a climber's spurs such as the telephone linemen use.

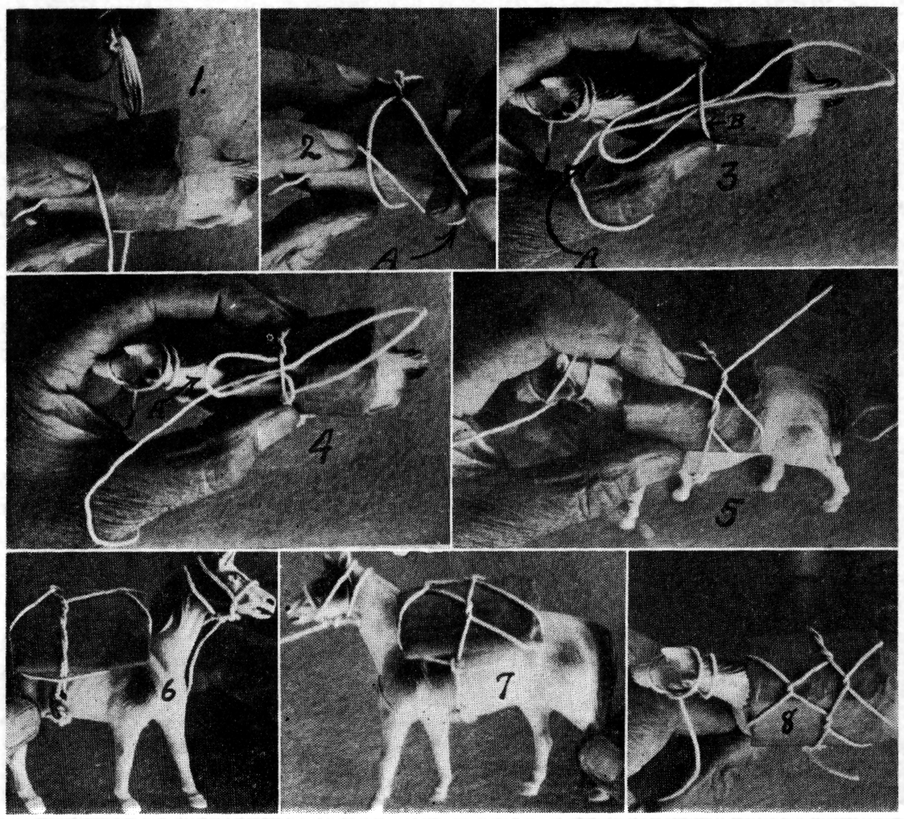
The Teamster's Hitch

The making of what is known as the teamster's hitch is shown in the four cuts herewith. The end of the rope is wound around two or three fingers of the left hand as shown in Fig. 1, the second round crossing the first and then the third time around, directly between the other two, as shown in Fig. 2. Then the second loop is woven over the end part and under the other loop as shown by the arrow. When this loop is pulled out, as is being done in Fig. 3, the resulting knot will look like Fig. 4. This knot has the qualities of a bowline, that is, it never becomes jammed, but may be easily untied and it does not slip.

The Diamond Hitch

One of the several varieties of diamond hitch for fastening a load on a pack animal is shown herewith. There are several advantages of the diamond hitch over any other method of fastening a pack. If properly done there is no necessity of reeving the rope through any rings or loops of rope and the whole pack may be tightened all around by the last pulls put upon the rope.

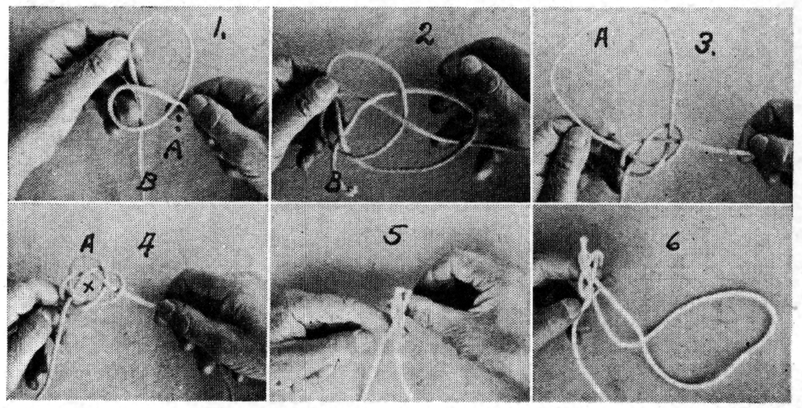
When the pack is to be removed there is simply one knot to untie and the whole rope can be lifted off without any snarls or knots left in it. It is somewhat difficult to show by pictures and printed descriptions what could easily be shown with the live animal and the actual pack. In the first place there should be a wide girth or cinch with a ring at one end and a large hook in the other. The pack rope which is usually three-eighth inch manila rope about fifty feet in length should have one end permanently fastened to the ring end of the cinch. In fastening the pack on the animal where two men work together, the cinch is passed under the animal to the man on the off side; the end of the pack rope is laid along the animal's



back over the pack so that the end is in front and the balance of the rope extending out behind. The man on the near side then pulls the rope end of the cinch up under the animal and passes a loop of the rope over to the man on the off side who puts the loop over the cinch hook. The man on the near side then pulls this up only reasonably tight and passes a loop of the rope marked A which he holds in his right hand under the other part marked B in Fig. 3 and does this twice. This will give him a picture of the rope which looks like Fig. 4. The part of the rope marked C is to form the loop which comes around the rear corner of the pack on the near side. Another similar loop to go around the rear corner on the off side is made by picking up the rope marked D inside the loop A and pulling it over to the rear as shown in Fig. 5. This Fig. 5 is defective in that it seems to show but a single rope pulled up through this loop. In reality this is a loop, and the other part being out of focus does not show. The other part of the loop goes around the front part of the pack on the off side and the end of the pack rope which was laid on top of the pack in the beginning of the process is now picked up and looped around the front corner of the pack on the near side of the animal. The end is then tied in a clove hitch around the part of the rope which comes up from the cinch and the pack is complete. A fairly good idea of the appearance of the pack is shown in the last three figures.

The Three-Strand Turkshead

The simplest form of a three-strand Turkshead, such as Boy Scouts use for a neckerchief slide, and which is used in many ways in ornamental rope work, is formed by first making what sailors know as the double carrick bend. The simplest way to make this is to make an over hand loop in one end of the rope marked A and lay it over the other rope as shown in Fig. 1. The end B is then carried over A, then under and over each

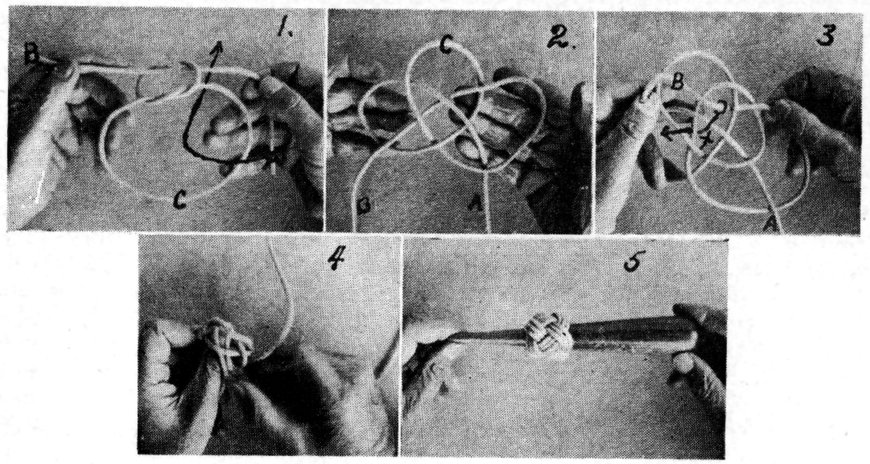


rope in turn as shown in Fig. 2. When the ends are pulled up we will have the Carrick bend as shown in Fig. 3. If now the part of the rope forming loop A, Fig. 3, is pulled down so as to be the same size as the other loops as in Fig. 4, we will have the starting of the Turkshead. By placing the center marked X over some round object and turning the loops so as to form a ring as in Fig. 5, the Turkshead may be finished by following one rope with the end of the other rope as shown in Fig. 6. This process is carried around and around until the rope is used up or until we have the strands as wide as we want them.

The Four-Strand Turkshead

The four strand Turkshead is somewhat more complicated than the three-strand and makes a wider band or ring. It is often used in making

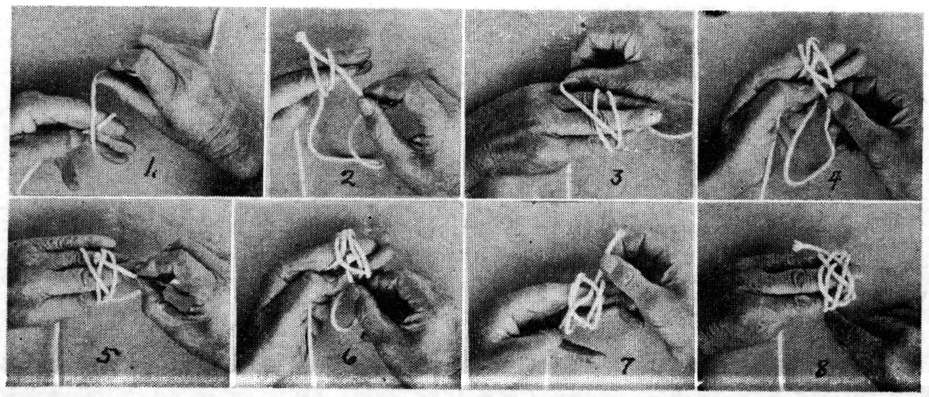
fancy napkin rings from rattan. The simplest way to teach the making of the four-strand Turkshead is first to loosely tie a square knot like the one shown in Fig. 1. Then turn the knot so that the end marked A passes



through the loop C. Then if the whole knot be turned over so that the loop C comes to the top and the other loops be spread out as shown in Fig. 2, we will begin to see how the Turkshead may be formed. The end B is now passed under the end A. then over and under each loop as we come to it as shown in Fig. 3. Then holding the opening X as the center, the loops are turned flat-wise around some round object to form the band or ring. Finishing this Turkshead is exactly the same as the finishing of a three-strand, that is, one of the ends is followed back by the other end so as to weave yarns in each strand as shown in Fig. 5,

The Five-Strand Turkshead

The five-strand Turkshead which is an ornamental knot, one step wider than the four strand heretofore described, is rather complicated in makeup, but produces a very interesting ornament when finished. The pictures shown herewith were made in an attempt to show how this knot is formed. It is best to practice it with a rather large piece of cord until one becomes accustomed to making it. In Fig. 1 a piece of cord about one-half the size of a lead pencil and something like three feet long is wound around the fingers of the left hand as shown in Fig. 1. After going around the second time the end is placed under the first turn of the rope as shown in Fig. 2. It is then carried back to the left over the back of the hand as

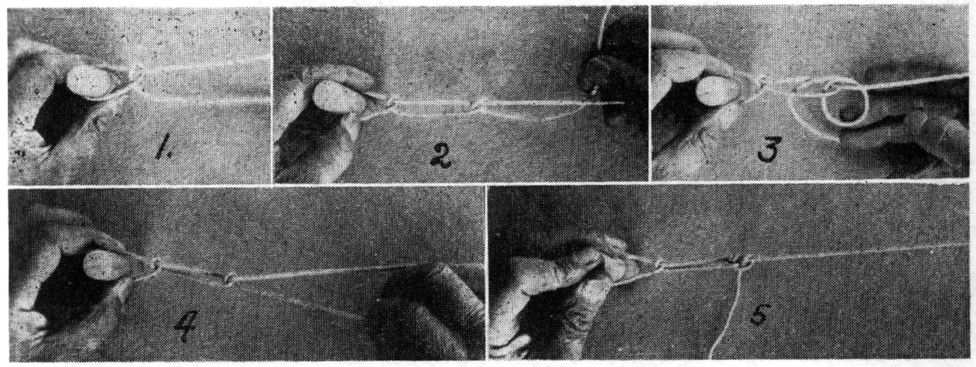


shown in Fig. 3 and brought up under the second turn parallel to the first part of the rope as shown in Fig. 4. Then it is carried around over the next rope to the right and placed under the middle rope at the back of the hand as shown in Fig. 5. It is then brought around over the part marked A under the part marked B and so on to the right of the braid and back under, over and under each turn as shown in Fig. 7. It will help in doing this last part to remember that in any perfect braid each rope extends across the braid from one side, to the other before turning back. If the person doing this will bear in mind how a five-strand braid should look, it will be a help in performing the last part of the operation.

Of course, this Turkshead as well as those already described, is to be finished by following one end of the rope with the other until each strand contains as many cords as the operator desires.

Midshipman's Hitch

This is a most useful knot, which should be better known and more often used than it is. It has several advantages over most knots. It is easily tied, it will not jam, and because the part of the rope bearing the strain is almost absolutely straight, it does not weaken the rope as is the case with most knots or hitches. The pictures show quite plainly how this hitch is



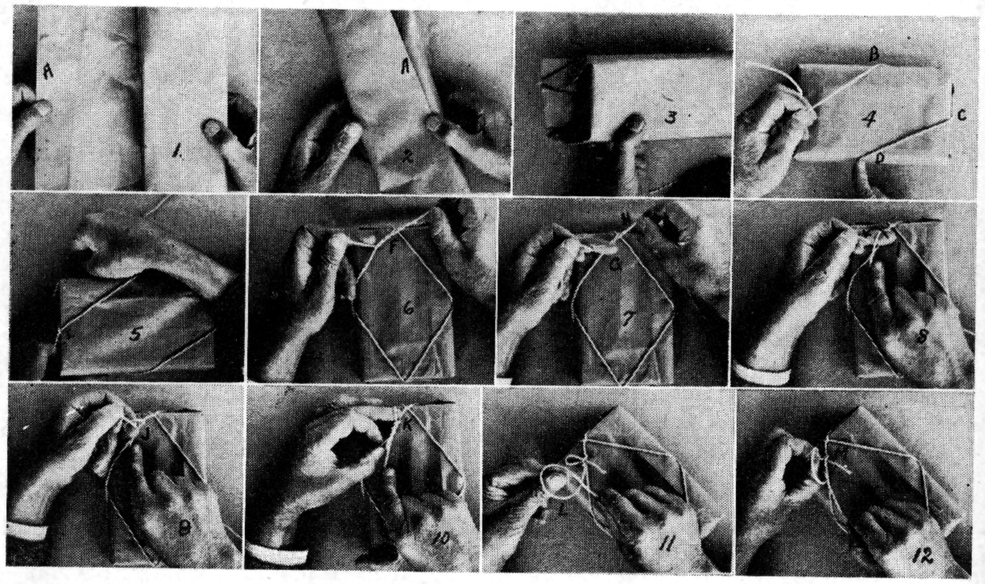
made. First, a half hitch is taken around the standing part of the rope, as in Fig. 1. Then at a little distance another half hitch is taken exactly like the first, as in Fig. 2. The end is then brought around and put through beside the second hitch and pulled down under it as shown in Figs. 3 and 4. A finishing half hitch is then taken at the right as in Fig. 5. This is the proper knot to use in a tow line in pulling an automobile out of the mud or in any situation where a great strain is to be put upon a rope.

Wrapping and Tying Packages

In the picture shown herewith the author has attempted to show first the proper way of wrapping paper about a book which is to be sent through the mail. Notice that the edge of the paper marked A is folded so as to be of double thickness of paper instead of leaving a single thickness at the outside of the package. Notice, too, that the size of the paper is so gauged as to bring this folded edge over near the edge of the book.

The ordinary way of proceeding from this point is to bend the paper down at both ends and fold it over. First, however, the package should be turned over so as to have the folded edge on the under side as shown in Fig. 3. The paper is then folded up at each end as shown in Fig. 4. The process thus far is the same no matter what method of applying the string is followed. From this point on in the first series of pictures is shown the method of tying about the corners so as to leave a large space for the

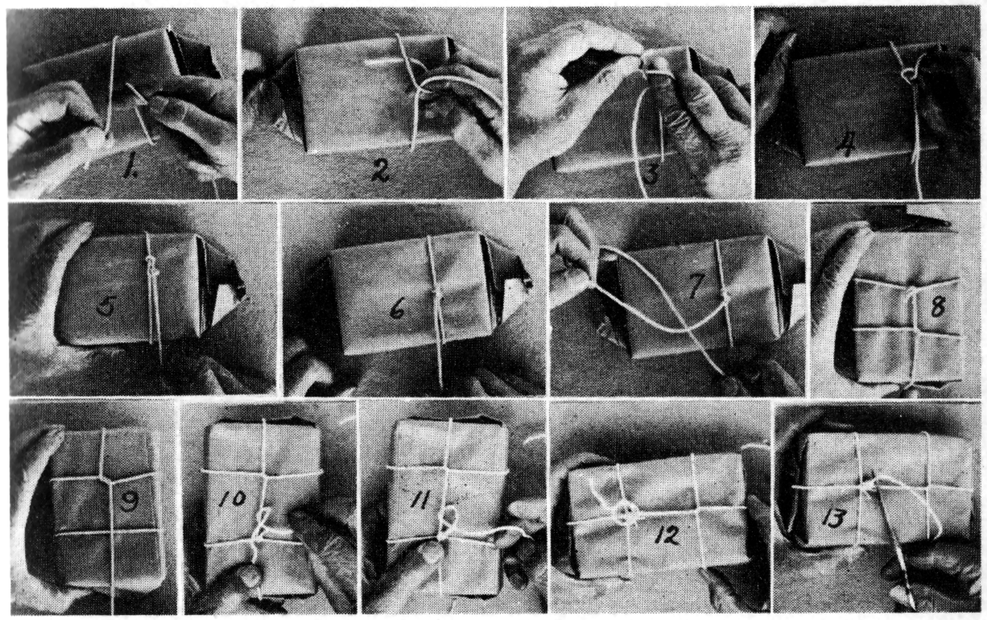
label. This method is not advisable unless the package is something stiff like a book and rather flat. This method has several advantages, one of them being that it is not necessary to turn the package over at all during the process. Notice that in Fig. 4 the string is held several inches from the end by the left hand while the standing part of the string is carried by the right hand across the middle of the edge at B under the corner and up at C, then down at D, around that corner and up at E as shown in Fig. 5. The standing part of the string where it crosses the other, goes under the corner as shown, then over the next corner, under the third corner and across the fourth corner to the point F as shown in Fig. 6 where the end of the string is passed twice around the standing part after the manner of starting a surgeon's knot. After doing this if the end and standing part are pulled up snug over the corner of the book so as to take all of the slack from the string, it will not be necessary for someone to hold his finger on the string while the finishing part of the knot is being tied. To finish the tying of the knot, lay the second finger of the left hand across the knot as shown in Fig. 7 then lay the standing part down across this finger as shown in Fig. 8 and reach back with this finger as indicated by the arrow, slipping the end of the finger under the end of the string and pulling a loop of it through under the standing part as shown in Figs. 9 and 10. This



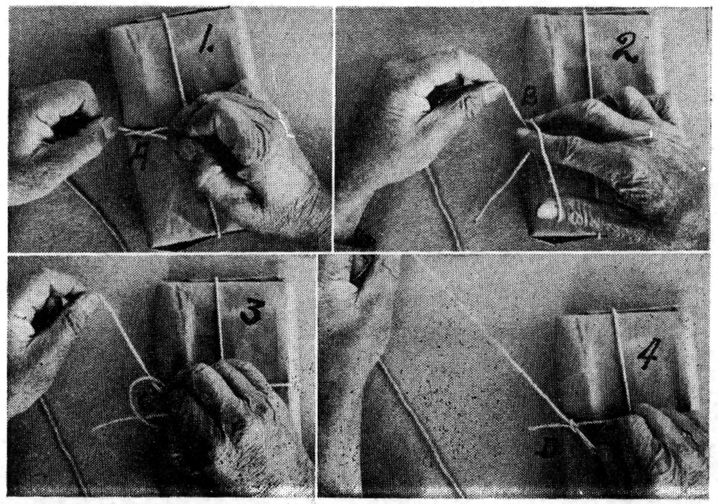
will make the surgeon's knot, leaving a bow or loop in the short end. The best way to finish and make this knot perfectly safe is to wrap the standing part of the string once around the left thumb and forefinger, forming a loop as shown in Fig. 11, then grasp the loop as shown in Fig. 12 and pull tight on the standing part. This seems like a long explanation for a little piece of work; but anyone who will follow these directions and learn to tie the knot this way will find it well worth the effort for with a little practice he can tie packages in this way faster than by any other method.

In the picture herewith shown we have a package wrapped with paper in the same manner as the one described in the last paragraph but we propose to put on the rope or cord in another way, using the packer's knot or, as the sailors call it, the jam hitch. Figs. 1 and 2 show how the cord is placed around the package, the end around the standing part and the forefinger of the right hand and under its own part. In Fig. 3 the forefinger of the right hand is shown under or through the loop of the string

but the thumb is hidden. As a matter of fact the thumb is also put through this loop with the forefinger where the end of the string is grasped and pulled back forming a figure of 8 knot around the standing part of the cord. If now the standing part be pulled up tight this knot will hold from slipping while the next step is taken in putting the cord about the package. This second step is simply placing a half hitch around the package as shown in Figs. 7 and 8, then the package is turned over and the end is placed once around each crossing of the cord on the back of the package. When the point of starting is reached it is finished by a clove hitch or two half hitches.



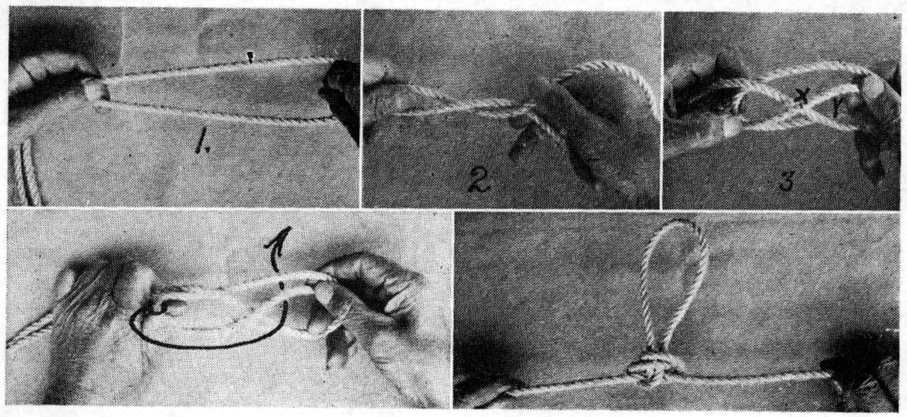
Another method of tying the knot after wrapping a cord around a package is shown in the accompanying picture. The end of the cord is turned only once about the standing part as shown in Fig. 1, then the cord where it crosses is held tightly by pressing the end of the second



finger of the right hand against it. The standing part of the string is then wrapped once around the forefinger and thumb of the right hand to form a loop as shown in Fig. 2; then the end of the string is picked up by this thumb and forefinger and the standing part is pulled so that the loop around the thumb and forefinger slips down and a pull on the standing part closes the loop and forms a firm knot. This is shown quite plainly in Figs. 3 and 4.

The Lineman's Loop

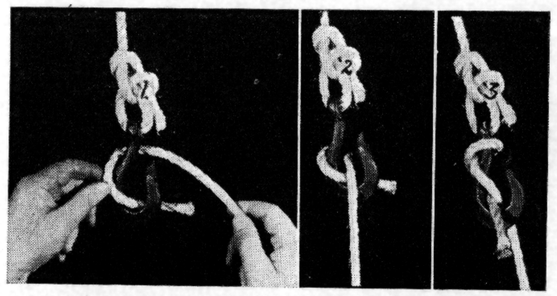
A knot which is shown herewith is called the lineman's loop. To make this loop take a bight of the rope, place the right hand through the bight and make one complete revolution producing what is shown in Fig. 2. The end of the bight A is then brought up between the two ropes next to the



left hand, then across the place marked X and through the opening marked Y. This is also indicated by the arrow in Fig. 4. Fig. 5 is the completed loop. It is like a bowline knot in that it will not jam; and is often used where a crew of men are to pull on a long rope and it is convenient for each man to have a loop rather than to pull on the straight rope.

Blackwall Hitch

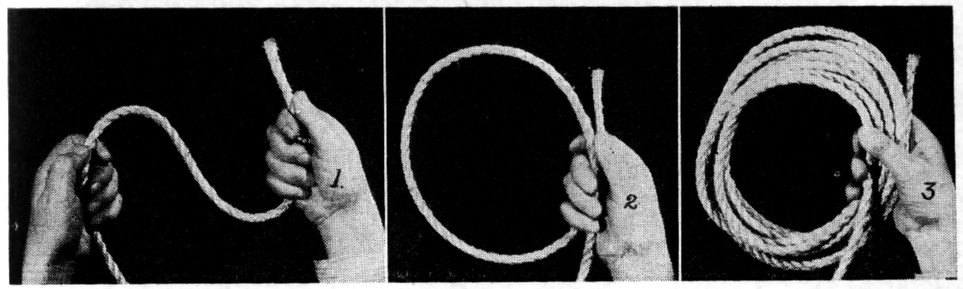
The Blackwall hitch illustrated here is a simple way to fasten a rope to a hook or to the crotch of a tree or limb without tying a knot. It will hold any strain that the rope will withstand as long as the rope is kept taut, but may be easily shaken loose when the strain is removed. It is useful in cases where it is desirable to use a rope in descending from a tree



or other high place. If fastened with this hitch, the rope may be loosened by simply shaking it vigorously. Fig. 3 shows what is sometimes called the double Blackwall hitch. It is considered a little less likely to slip when used on a big hook.

Coiling and Throwing a Rope

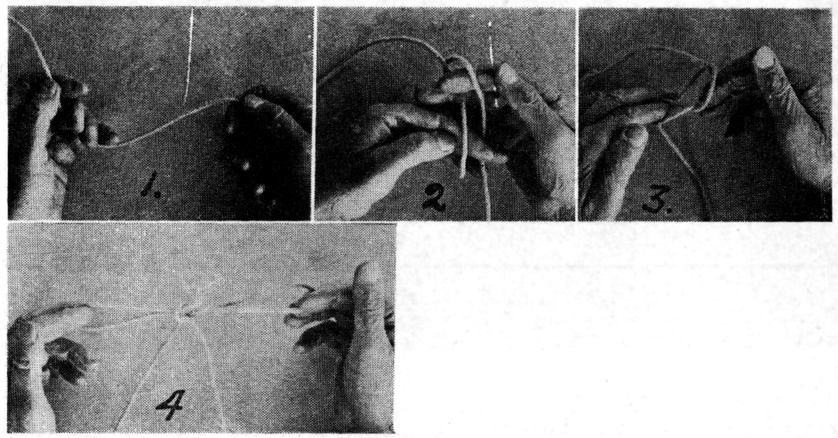
Rope, owing to the way it is twisted, will usually coil up in one direction without trouble whereas if coiled in the wrong direction it will become twisted and bothersome. All ordinary rope is what ropemakers call right-handed rope and should always be coiled toward the right or in the direction of the movement of the hands on a clock. If a rope is to be thrown to a person out in the water or to someone up on a scaffold it should be coiled in the hand which is to do the throwing and coiled toward the right. The last end of the rope should be held onto by the left hand while the right hand throws the whole coil toward the person for which it is intended. The author has seen a troop of Boy Scouts get a good deal of



fun out of a game of throwing the rope. They used a piece of half inch rope fifty feet long and threw it across the hall at a boy who was sprawled out upon the floor playing the part of a drowning man.

Tom Fool's Knot

What sailors know as the Tom Fool's knot and which is mainly a trick knot but which may be used to form a pair of handcuffs, is shown in the picture. The tying of it, or rather the learning how to tie it, is a good test of a person's powers of observation. In making it, the string or rope is grasped in the hands as shown in Fig. 1, the hands are spread apart a foot or two and the portion of rope between the two allowed to

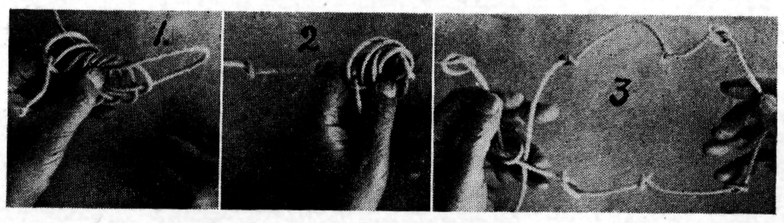


drop down while the hands are brought together, with the right hand in front of the left as shown in Fig. 2. The left hand end of the rope is then grasped by the first and second fingers of the right hand and the right hand end by the first and second fingers of the left hand and then these parts are simply pulled apart as in Figs. 3 and 4. It is very easy to do when a

person learns how. The trick part of it is simply the fact that most persons will not notice how the rope is grasped in the first place and will fail to get hold of it in the right way.

The Fire Escape Knot

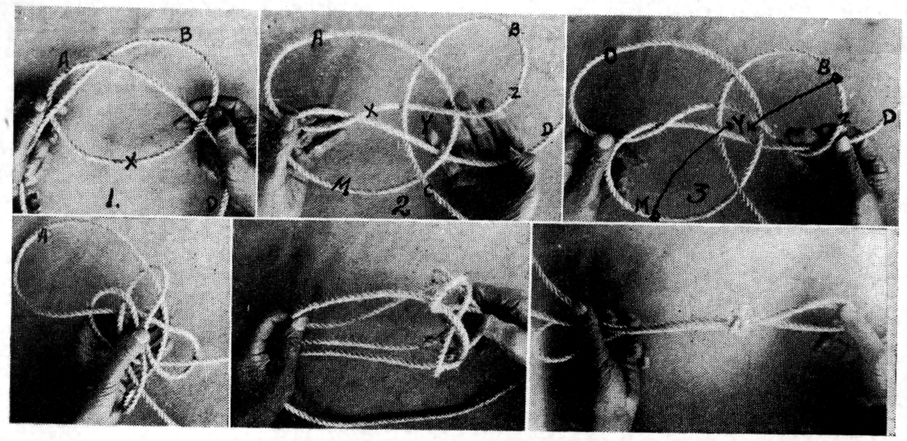
A rope trick which is often shown upon the stage but which may have a useful application is done by laying a series of underhand loops in a row, one upon the other after the manner of setting up stitches for plain knitting.



Such a series is shown in Fig. 1 of the above picture. After laying up ten or a dozen of these loops if the end of the rope is run through all of the loops and pulled out from the other side there will result an overhand knot for each one of the loops. In playing the trick the person doing it lays up the loops and then asks some innocent party to pull the end out. The result is a knotted rope as shown in Figs. 2 and 3.

The Theodore Knot

This rather complicated knot, which looks like a Turkshead with four separate ropes extending out from each side of it, is called the Theodore knot. It is used by cowboys in making a fancy bridle partly of rope and partly of leather. The author once knew a cowboy who could tie this knot and who did tie it for his brother cowboys for a good price per knot, but would never teach anyone else how to tie it. The cuts shown herewith illustrate a simple way of forming this knot which is done as follows: First,



near the middle of the rope a simple over hand knot is loosely tied so that it looks like Fig. 1. The part of the rope marked C is next moved over to the right as shown in Fig. 2 and the end D is passed under C and around the lower part of the rope forming the loop A at the point marked X. It is then carried across C and under the rope next to the right as shown in Fig. 2 and then around the lower part of the loop B near point Z as shown in Fig. 3. Now if the loops B and M are passed through the middle of the knot at Y and pulled out to the other side, at the same time holding the

ends D and C and the loop A together, the Theodore knot will be produced. Fig. 4 shows these two loops being poked through the opening at Y. Fig. 5 shows these two loops being taken on the other side by the right hand and Fig. 6 shows how the knot looks after it is pulled tight. The author once saw the tying of this knot illustrated in a book where several pages of printed matter and about twelve pictures were used to show how to form the knot by using one end of the rope. This was such a complicated matter that after the knot was finally produced he took it apart, step by step, and evolved the method shown above. My friend, the cowboy, maintained this was not the right way to tie the knot but had to admit that it produced the same result so his complaint was ignored.

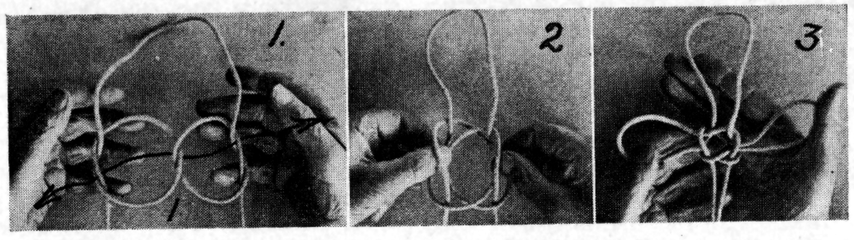
English Diamond Knot

The English diamond knot is one of those knots which looks like a Turkshead with two ropes extending out from each side. The difference between this and the Theodore knot is that there are two ropes from each side instead of four. The beginning of this knot is a carrick bend with ends on opposite sides. The pictures show quite plainly how it is made; but Fig. 1 is defective because in trying to make the picture small the rope is cut off and does not show as it should that the parts connected by the dotted line form a loop and are not separate ropes. The end B is laid over end A, then an underhand loop is made in A and laid across B as shown in Fig. 2. The end B is then brought under end A and then over the right side of the under hand loop; then under the rope B as shown in Figs. 3 and 4. The end A is then carried around past the standing part B and up

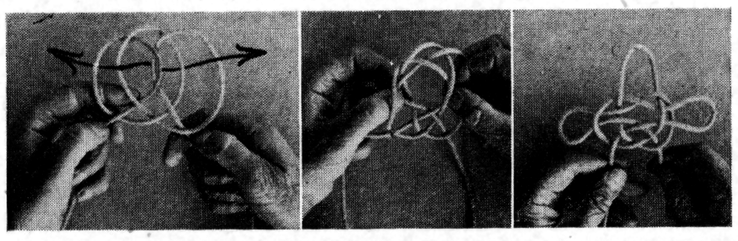
through the middle of the knot as shown in Fig. 6. The end B is then likewise carried around the standing part of A and brought up through the middle of the knot. When the two ends are pulled up evenly the round knot shown in Fig. 8 is produced.

The Shamrock and Masthead Knots

Two fancy knots which are often used in braid work are the shamrock knot and the masthead knot. The latter also is used in a practical way for the fastening of guy ropes at the top of a mast or spar when it is raised. The shamrock knot shown herewith is made by first tying two loose overhand knots near the middle of a piece of rope or twine, the second knot passing through the first one as shown in Fig. 1. The two parts of the overhand knots in the middle are pulled through the crossings of the over-

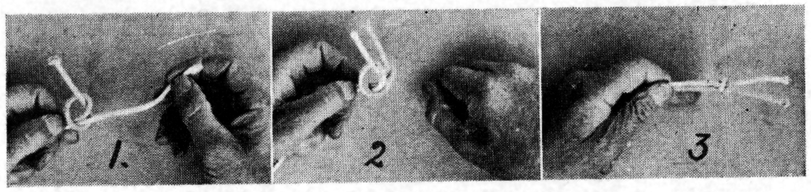


hand knots as shown by the two arrows. These, when pulled out to the proper size to match the loop in the middle of the rope will make something which looks a little like the shamrock leaf. The masthead knot is made by laying up three underhand loops exactly in the same manner as in the making of the simple sheep shank, then the sides of the outside loops are woven from the middle to the outside as shown by the arrows of Fig. 1 and by the Figs. 2 and 3.



Bridle Rein Knots

Two methods of tying ornamental knots in the ends of bridle reins are here shown. The first three figures show the two-strand way of making a double Walker knot such as has already been described for finishing a three-strand rope. In Fig. 1 the first strand has been carried around the



other strand and put through its own loop. The second strand is laid down in like manner, carried around the rope and put through both the loop in the first strand and its own loop. This is plainly shown in Fig. 2. Fig. 3 shows the knot as it has been pulled tight. Figs. 4, 5 and 6 show the making of a wall knot with only two strands. One strand is laid down as shown in

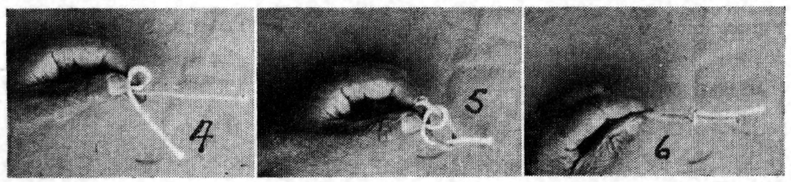
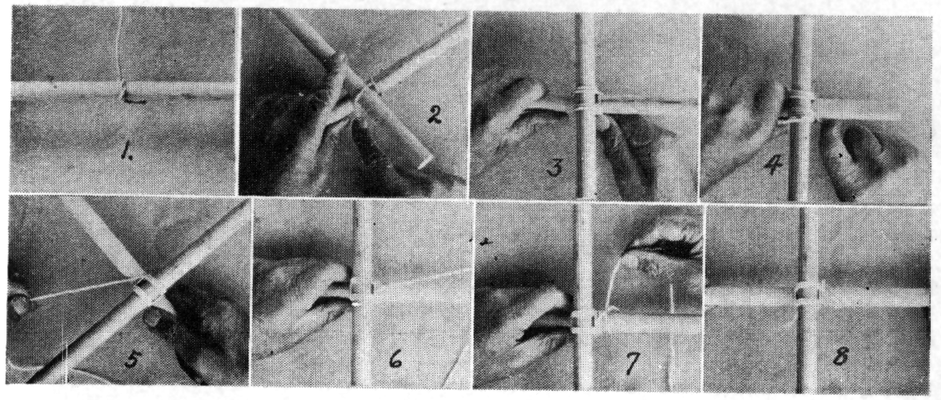


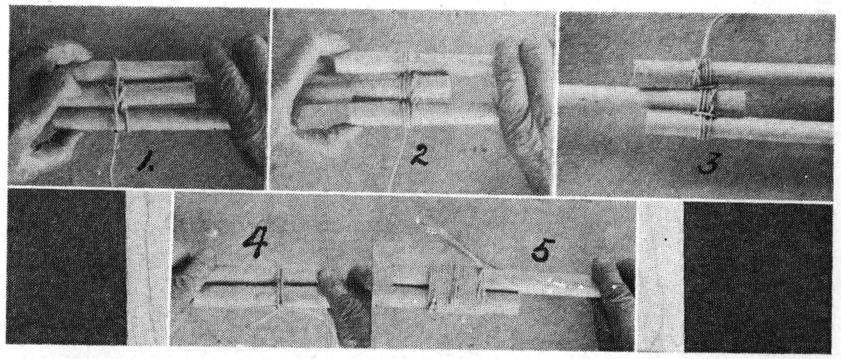
Fig. 2, leaving a loop. The second strand is carried around the end of the first strand and through the loop of the first strand as shown in Fig. 5. Fig. 6 shows the completed knot pulled tight.

Lashing



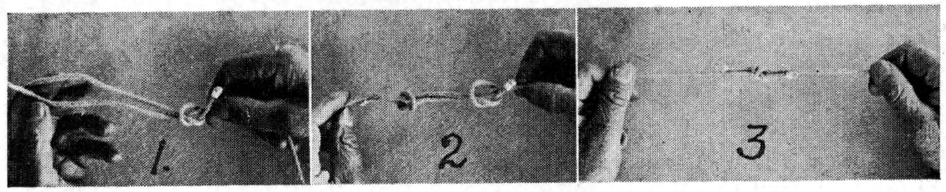
A method of lashing two staves or spars together is shown herewith. A start is made by using either a clove hitch or a timber hitch as shown in Fig. 1, then winding the rope about both of the staves or spars after the manner shown in Figs. 2, 3 and 4. Notice that the rope is carried each time straight across the opposite spar and never diagonally across either one. After wrapping the rope three or four times about the spars as shown in Fig. 4 the whole is tightened by wrapping the rope around the crossings of the rope two or three times as shown in Figs. 5 and 6 and finished with a clove hitch as shown in Figs. 7 and 8. This is the usual method in making a lashing where the spars cross each other at right angles.

The next pictures show how the ends of staves or spars may be lashed together to form a tripod. The ends are laid together as shown in Fig. 1.



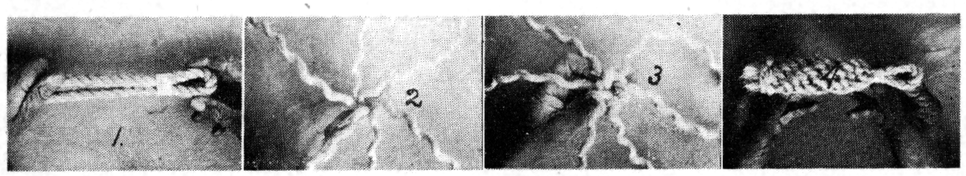
The start is made with the timber hitch and the rope woven about as shown in Fig. 2, then tightened by being wrapped as shown in Fig. 3 and finished with a clove hitch. The person who does this must use some judgment as to the degree of tightness of the lashing, remembering that when he comes to set up the tripod the rope will be tightened considerably and if it were too tight at the start it might be broken. Figs. 4 and 5 show how two staves or spars may be lashed together by a simple weaving started with a clove hitch as shown in Fig. 4 and finished with a final clove hitch as shown in Fig. 5.

The Fisherman's Knot



The fisherman's knot, sometimes called the Englishman's tie, used to tie fishlines or other small lines together, is made by tying a simple overhand knot in each and around the standing part of the other rope. The process is shown herewith in Figs. 1 and 2 and the finished knot in Fig. 3.

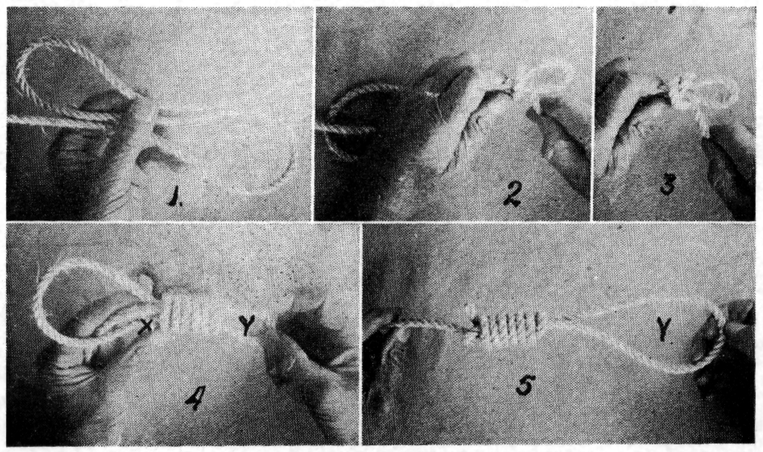
A Boat Fender



The picture above shows one application of the crown knot. In this case a half inch rope was doubled back upon itself and the two parts lashed together with a whipping similar to that usually put upon the rope's end.

The strands were then unlaid and spread out as shown in Fig. 2, then a crown was made of all six of the strands by laying each one in turn over the one next to it toward the left and tucking the last one through the loop in the first one. It will be noticed that this is exactly the same process as forming the crown in the three strands in the case of making the back splice or spliced end already described. This process of crowning is repeated in the same direction, that is, always going towards the left until the fender is the desired length, when it is finished by putting each end around the strand next to it and pulling it up through the middle after the fashion of a man-rope knot which has been already described. In making large fenders sometimes more than six strands are used and some sort of filling like old pieces of rope, etc., are placed in the middle and the outside built around it.

The Hangman's Noose



The process of making this knot is here given in the hope that whoever makes it will never use it in the way which gives it its name. Fig. 1 shows how the rope is doubled to make two loops and Figs. 2, 3 and 4 show how the end is wound around the other parts and tucked in at the point marked X. The loop Y is then pulled out so as to tighten the loop around the end. and the knot shown in Fig. 5 will be the result.

SQUARE KNOT WORK

Square knot work, like the art of netting, has been employed by sea faring folks for many generations as a diversion during long journeys on the high seas. Many useful articles have been developed and afford a wide range of interesting patterns and designs through the application of a few simple elementary processes in cord manipulation. The elements and principles may be acquired in the making of the simpler projects. Lanyards for pencil, whistle, knife, compass, dog leash, shade pulls and belts suggest themselves. Handbags, Table Mats, Runners, Centerpieces may be left for the advanced work and for detailed specification and instruction consult the Square Knot Book, by P. S. Herwig, 97 Sands St., Brooklyn, New York.

The only tool required in square knot work is a tension hook. The construction of a satisfactory hook made of wood is shown on page 347 This hook is attached to a cord which is tied around the waist of the person engaged in square knot work. One end of the cord work is attached to a rigid support as indicated in Fig. 7, Cut 1. The other end of the cord work, that is two of the four cords are attached to the tension hook. Tension is placed on the attached cords when the operator moves back to the proper distance thereby removing slack in the cords between the hook and the fixed support. Tension is removed by a forward body movement of the operator.

The Principle of Square Knot Work

A method of tying the square or reef knot is given on page 366. It will be noticed that each loop encloses both ends of the rope or cord which forms the opposite loop. Also that both parts of each rope are parallel after the formation of the loop.

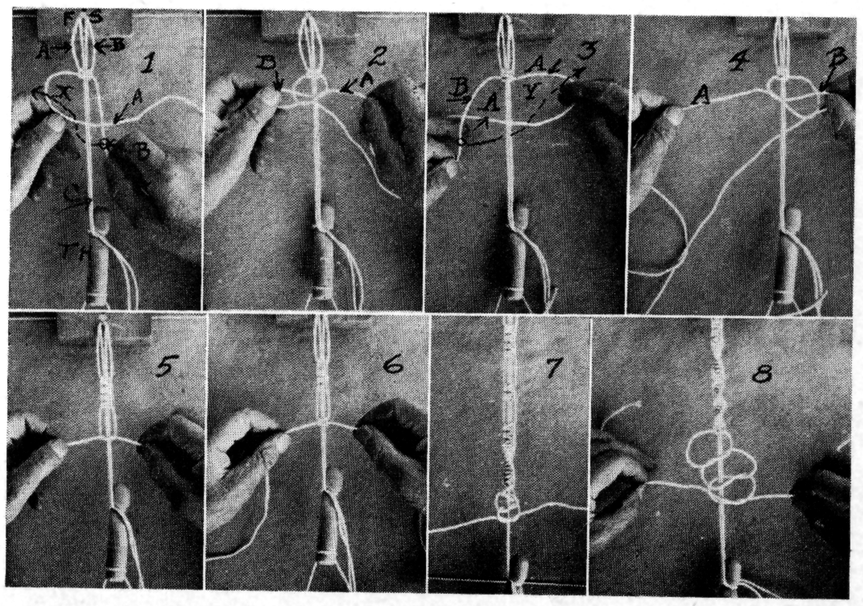


Fig. 7

Four cords are required to build up the square knot element. Two cords are used as a core or mandrel over which a series of square knots are formed adjacent to each other. Refer to Fig. 7, Cut 1, which shows the square knot element. The two center cords are held taut between the tension hook and the fixed support. A single square knot has been tied with cord A and B.

Formation of the Square Knot

Step 1. Form loop X by carrying cord A across the core C. Fig. 7, Cut 1.

Step 2. Place cord B over cord A and carry it under the core and up through loop X as indicated by the arrow. Cut 2 shows the process of drawing the loop up snug and pulling the cord B through the loop. This makes one-half of the square knot.

Step 3. Form loop Y, Fig. 7, Cut 3 by carrying cord A across the core C.

Step 4. Place cord B over cord A and carry it under the core and up through loop Y as indicated by the arrow. Cut 4 shows cord B being pulled through the loop prior to pulling the cords tight which completes the square knot. Other square knots are formed in the same way. Cut 5 shows five finished square knots and the first half of another which is to be spaced a short distance from the preceding one. Cut 6 shows the completed knot and the open mesh between it and the series of five preceding knots. This process yields a flat strand approximately 5 cords wide and two cords thick.

Spiral Formations

A pleasing variation in the strand is produced by making a series of half knots in succession. By repeating the half knot illustrated in Fig. 7, Cuts 1 and 2 a spiral is produced as shown in Cut 7. A repetition of steps 1 and 2 produces a right hand or clockwise revolving spiral. By repeating steps 3 and 4 a left hand or counter clockwise spiral is produced.

Additional Variations in a Four Cord Structure

Refer to Fig. 8, Cut 3 which shows several changes suitable for use in a lanyard, dog leash or shade pull. The section at A is a four plait round. See page 106 for construction detail. This plaited section is terminated by a

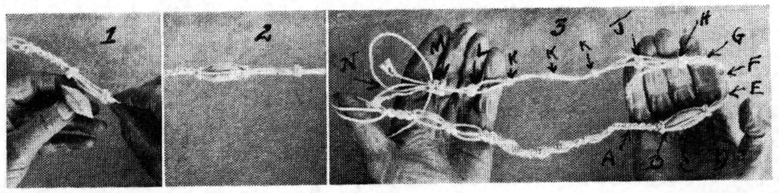


Fig. 8

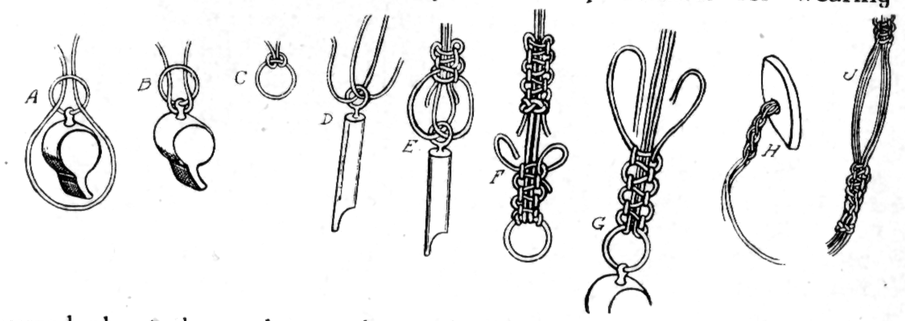
terminal turkshead B, detailed on page 107. Section C shows an insert bead or locket, Cuts 1 and 2. Another terminal turkshead is placed at D. Section E is made to resemble a twisted strand rope. Apply the method given for relaying the end of a raveled rope, page 377. This section is terminated by a Matthew Walker knot, which is described on page 385. Section G is another plaited section of four plait flat. Construction details are given on page 108. This is ended by a terminal turkshead. Beyond the point two cords only are used in continuing the structure.

Variations in Two Cord Structure

It requires approximately five times as much cord to produce a square knot strand as is needed for the core. At point K, Fig. 8, Cut 3, only the core remains. The cords used to form the square knot work and the additional structure have been worked up. At point J a two strand turkshead is shown. See page 80 for construction detail. At the three points marked by the letter K the wall knot is shown. This is detailed on page 383. An English diamond, described on page 401, is tied at point L.

Terminals

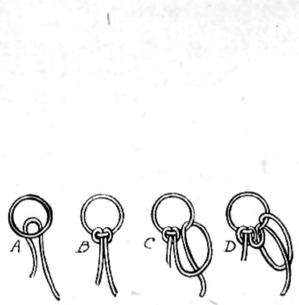
The purpose for which a strand is made will determine the appropriate type of terminal to be chosen. A lanyard may be started on a toggle as shown in the Sketch H. An adjustable loop suitable for wearing the

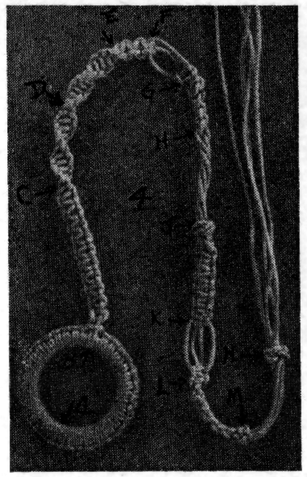


lanyard about the neck may be made by inserting the toggle between the core cords in one of the open meshes as indicated in Sketch J. The terminal shown on page 385. Cut 3, at the point N is a convenient one to use when the lanyard is to be attached to a ring or other fitting of the pen, pencil, whistle, knife, etc. There are two ways of using this style of terminal. One is to pass both cords through the ring of the article to be suspended and use the free ends to form two or more square knots upon the core thus formed, see Sketches D, E. The free ends may then be tucked back down the center of the square knot work, Sketch F. The method attaches the lanyard permanently to the pendant, which cannot be removed unless the square knot work is undone. The other method is to make the same type of terminal independent of the article to be carried. It is attached by threading the loop through the ring of the article, far enough through to permit the end loop to pass over the article and be drawn up snug about the ring at the top.

A Shade Pull

The construction detail for the four cord square knot structure applies to this project. The method of covering the ring used is depicted in Fig. 9, Cuts 1 to 3. The first step is to attach the cord to the ring by forming the larkshead, see page 408. This is done by passing a loop, formed at the middle point of the cord, up through the ring from below and passing both ends through the loop. The cord thus attached is shown in Cut 1. The free ends of the cord are separated and half-hitches are formed around the ring as indicated in Cuts 2 and 3. The first half hitch shown in Cut 2 is made by passing the right hand cord up through the ring and down through loop X. The cord is then pulled taut so that the half hitch grips the ring tightly and is seated snugly against the larkshead. The second half hitch shown in Cut 3 is made by passing the cord down through the ring and up through the loop Y. Continue the half hitch construction work alternating steps as shown in Cuts 2 and 3. The completed shade pull shown in Cut 4 indicates the location of the larkshead, also the covered ring. At point B another cord is passed over the ring between the last two half hitches and





this forms the core for the half hitch work. The section between B and C is flat square work, C to D a right hand spiral, D to E a left hand spiral, E to F flat square knot work, F to G an open mesh, G to H four plait round, H to J twisted spiral, J to K flat square knot work, L to M four plait round, M to N terminal Turkshead knot.

Starting the Belt: **A Square Knot Belt**

The procedure developed for the four cord square knot work applies wherever there are additional cords in multiples of four. The detail has been worked out with twelve cords. Cut 2 shows the method of attach-

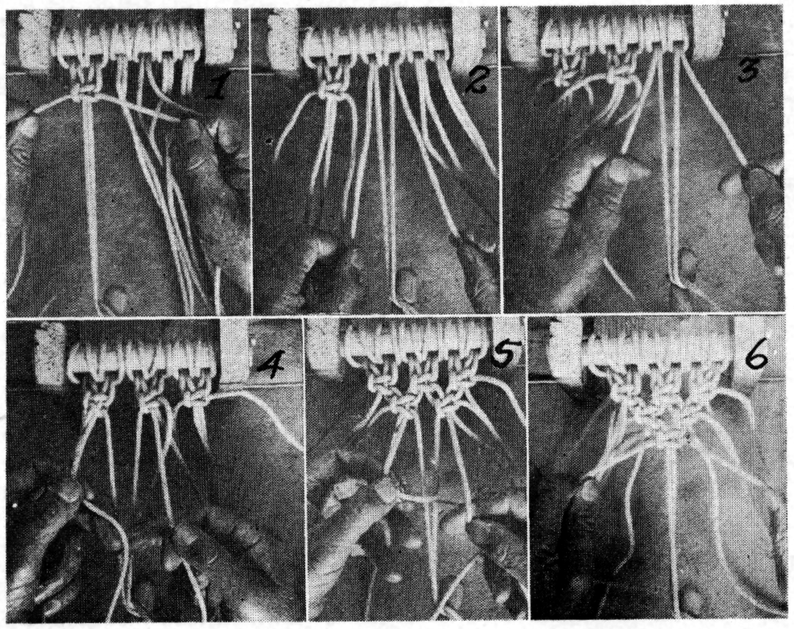


Fig. 10

ing the cords to the buckle bar, also a central pair of cords held taut by looping around the tension hook, and the first complete square knot. Cut 3 shows the tension placed on the core cord prior to the construction of the

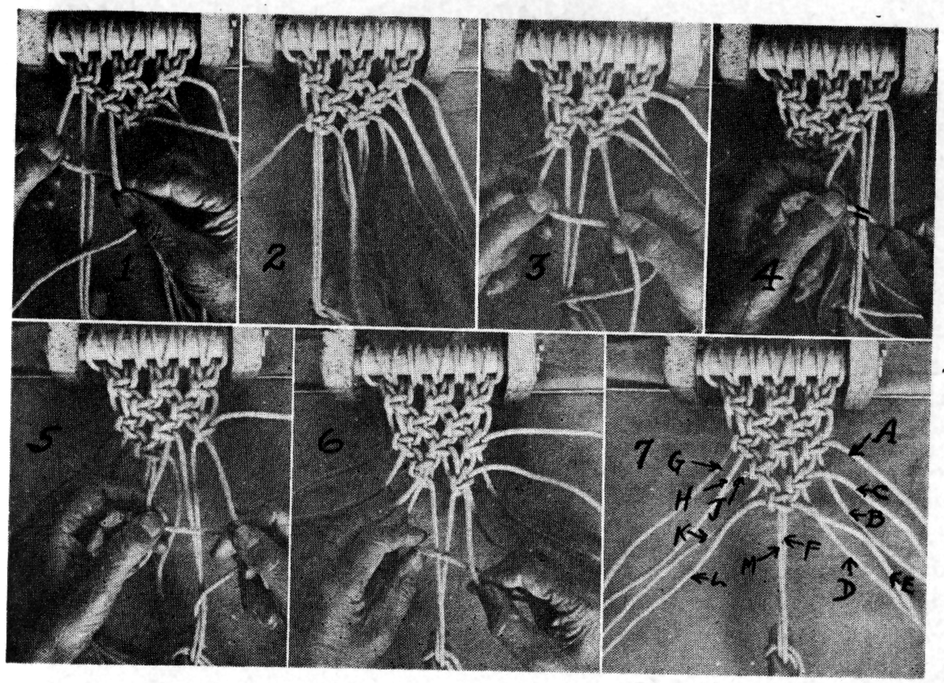


Fig. 11

second square knot. Cut 4 shows the second square knot completed, also the tension placed on the core cord of the third square knot. Cut 5 shows the third square knot finished and the tension placed upon the core cords of the fourth square knot. Cuts 5 to 6 show the completion of the fifth and sixth square knots. Cut 7 refers to the half-hitch work described on page 410.

Notice that the open spaces between each square knot are uniform in size. Use the center row of meshes near the end as holes for the buckle tongue.

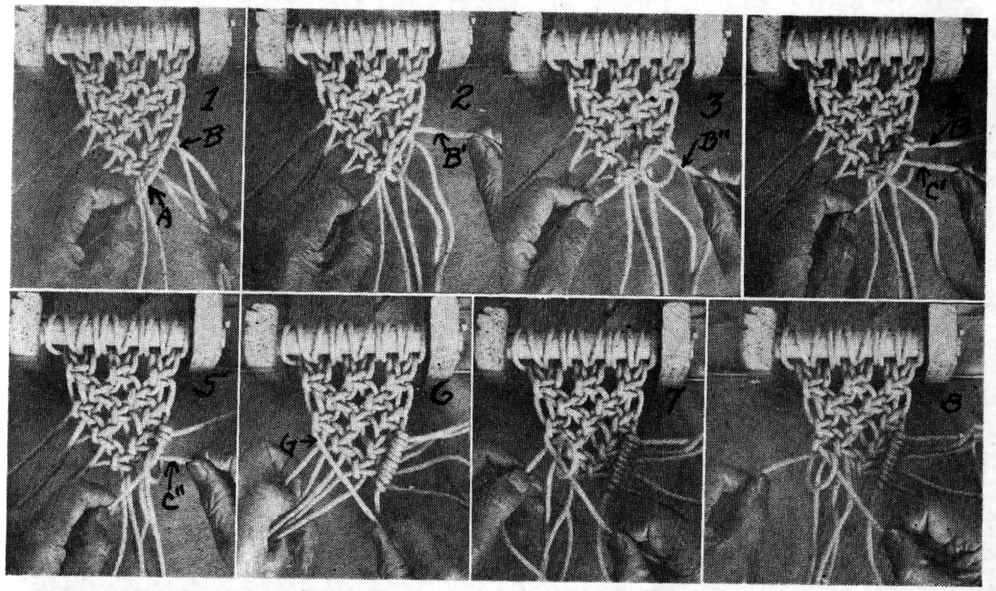


Fig. 12

Half Hitch Work

A pleasing variation in pattern is obtained by introducing open meshes and half hitch work as indicated in Fig. 13, Cuts 1 to 7. Refer to Fig. 11, Cut 7, which shows the cords A to E just below the square knot work as shown in Fig. 12, Cut 1. Cord B is half hitched over cord A as shown in Cut 2 and again as shown in Cut 3. Each cord, B to F, Fig. 11, Cut 7, in turn is half hitched twice over cord A as a core. This process is repeated for the left side. Cord G, Fig. 11, Cut 7 also Fig. 12, Cut 6 is carried across cords H to M and each in turn half hitched over it in the same way described for cords B to F. Fig. 13, Cut 1 shows two rows of half hitch work completed, also open mesh below the arrow X. One half hitch is made by each cord around the core cord of the last row of half hitch work above. Each cord to the left of cord Y, Fig. 13, Cut 1 is to be snugly half hitched around Y as a core. The process is shown in Cut 2 and completed in Cut 3. Another V shaped row of double half hitches is shown in Cuts 5 and 6, and the square knot work again resumed. Cut 7 shows additional half hitch work. Any of the variations in pattern shown for four cord square knot work may be used in the belt.

Ending the Belt. In Fig. 13, Cut 1, two rows of half hitch work are shown as described in the following paragraph. A satisfactory ending for

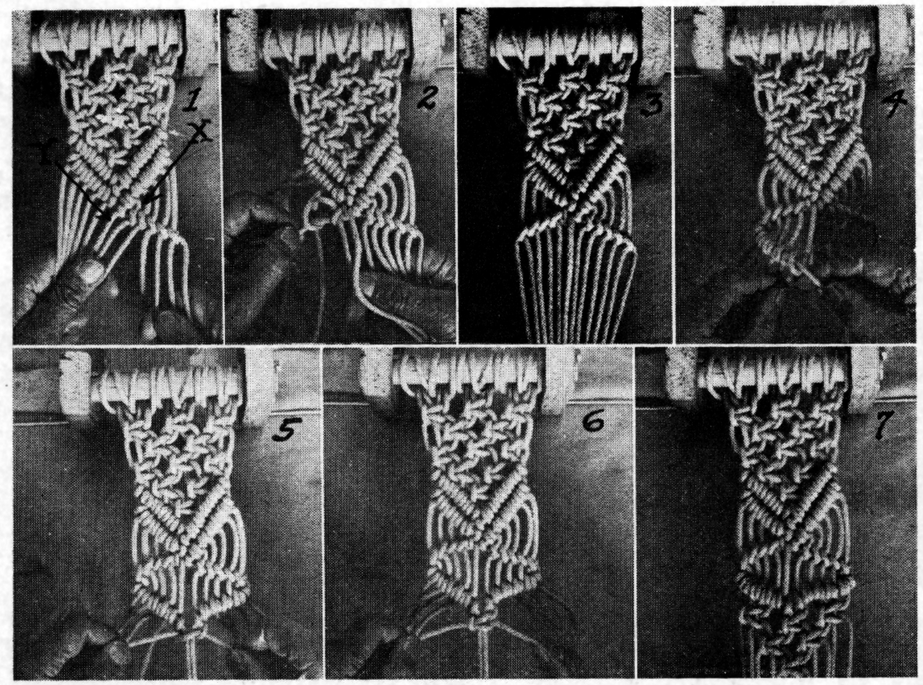


Fig. 13

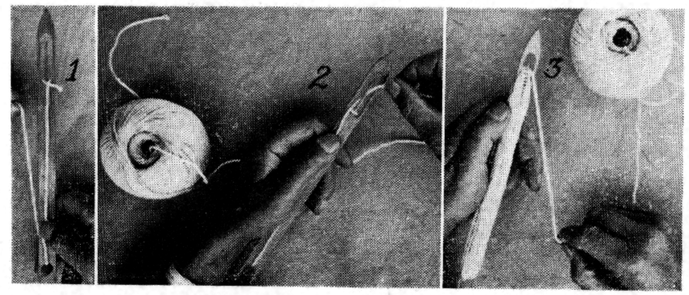
a belt is secured by cutting the cords protruding from the half hitch work close up to the last row of hitches as indicated by the direction of the arrows X and Y.

NETTING OR CORD WEAVING

The sheet bend or weaver's knot described on page 370 is used in the weaving process employed by fishermen in making their nets, whence comes the name, netting. Several projects suggest themselves: Basketball Baskets, Tennis Nets, Hand Bags, Hammocks and others. The process in constructing a hammock will be described, since this project involves the problem of tapering the ends whereas the other two projects mentioned are of uniform width throughout.

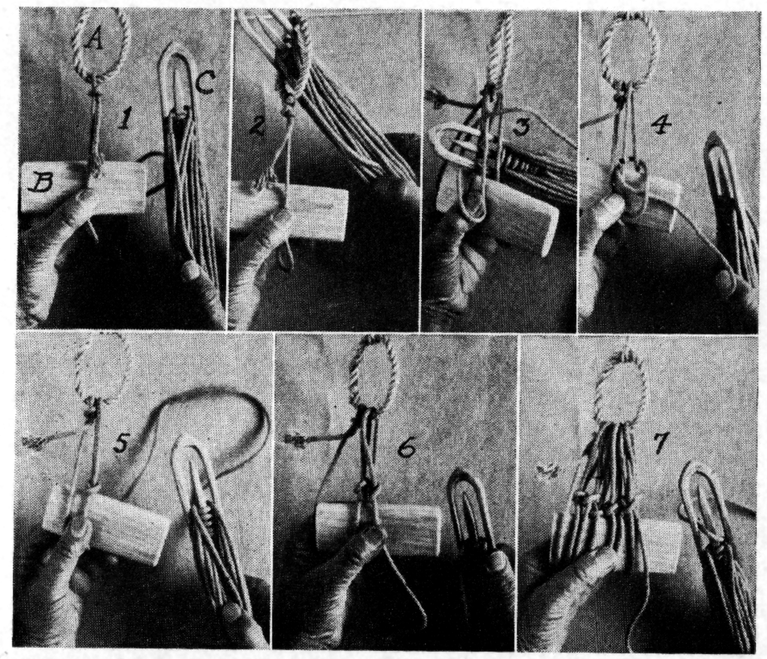
The Tools needed are: Needle and mesh stick, both of which are made as indicated on page 414. The needle is threaded or loaded as shown in Fig. 1, Cuts 1, 2 and 3. The mesh stick Sketch B, Cut 1, Fig. 2 is used as a mandrel on which each mesh is formed.

Fig. 1



The Material is cord of a size appropriate for the project, and a support for the weaving. This may be a rope, grommet or metal ring.

Fig. 2



Instruction. Formation of attachment loops.

The first step in the construction of a hammock is the formation of the loops, Fig. 2, Cut 1. The support (A) to which the free end of the cord running from the needle is attached is a rope grommet, constructed as shown on page 383. A simple overhand slip knot is tied as in Sketch D, page 414.

The mesh stick B, Cut 1 is placed behind the cord and held in position by the pressure of the left thumb. The cord is carried under the mesh stick and through the grommet as indicated in Cut 2, and again brought down across the mesh stick. It is held in position by the left thumb, Cut 3, while the weaver's knot is tied by passing the needle behind the two vertical parts of the cord and through the loop. Cut 4 shows the weaver's knot loosely formed and Cut 5 the knot tightened and resting on the upper edge of the mesh stick. This process is repeated in forming the additional loops, Cuts 6 and 7. When the desired number of loops have been made the mesh stick is removed.

Formation of the Mesh

The length of the mesh is controlled by the width of the mesh stick. A single mesh is made by carrying the cord around the mesh stick once. A double length mesh is formed by making a second turn around the stick before tying the weaver's knot. Cut 1, Fig. 3 shows the completion of a double length mesh and the finished weaver's knot. Cut 2 shows a series of

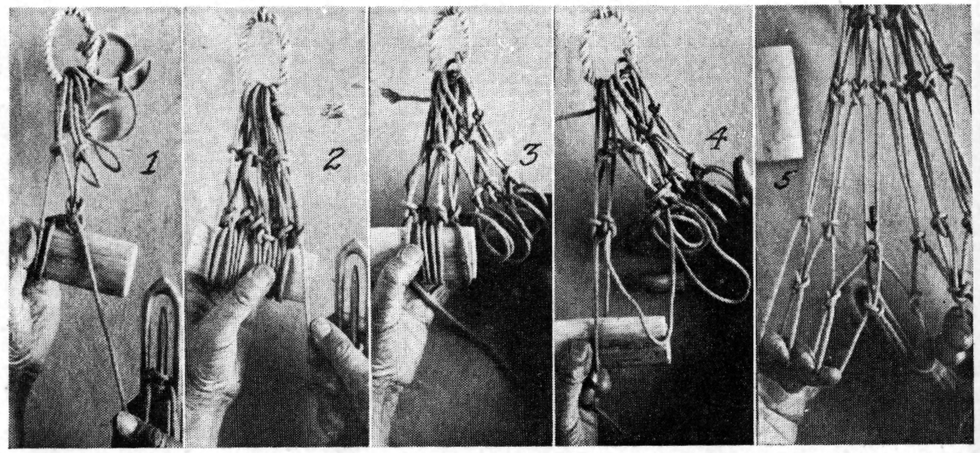


Fig. 3

double length mesh. The mesh stick is removed, Cut 3, and the double loops opened out to single mesh twice the length of the first row of loops.

Addition of mesh to increase the width of the hammock. Cut 5, Fig. 3 shows an extra loop added between the second and third mesh. In the same way extra mesh are added in Fig. 4 which shows the widening process step by step. As the row is formed one extra loop is added between the sixth and seventh mesh. Cuts 3 and 4 show the completion of two mesh and the method of inserting the needle into an upper mesh row and between mesh 2 and 3 of the lower row. Cuts 4 and 5 show the completion of the row.

Reduction of mesh to decrease width. The method of reducing the width is illustrated in Fig. 5. In the formation of this row, a single loop is made for the sixth and seventh mesh in the row above. In Cut 1 the needle is ready to pass through two meshes. Cut 2 shows them drawn to the upper edge of the mesh stick and Cut 3 the loosely tied weaver's knot. In Cut 4 the knot is tightened and the mesh drawn down to position on the upper edge of the mesh stick.

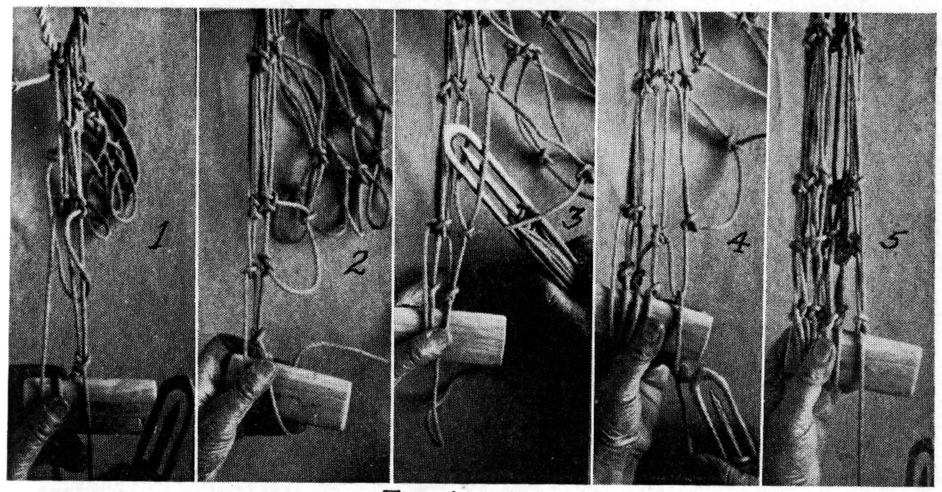


Fig. 4

In the method of netting described two operations are required in the formation of the weaver's knot. The needle is first passed through the loop as in Fig. 4, Cut 4. Then the needle is again passed behind the taut loop and the weaver's knot completed as shown in Fig. 1, Cuts 3 and 4. These steps may be reduced to a single pass of the needle in the process known as the Martha's Vineyard Method.

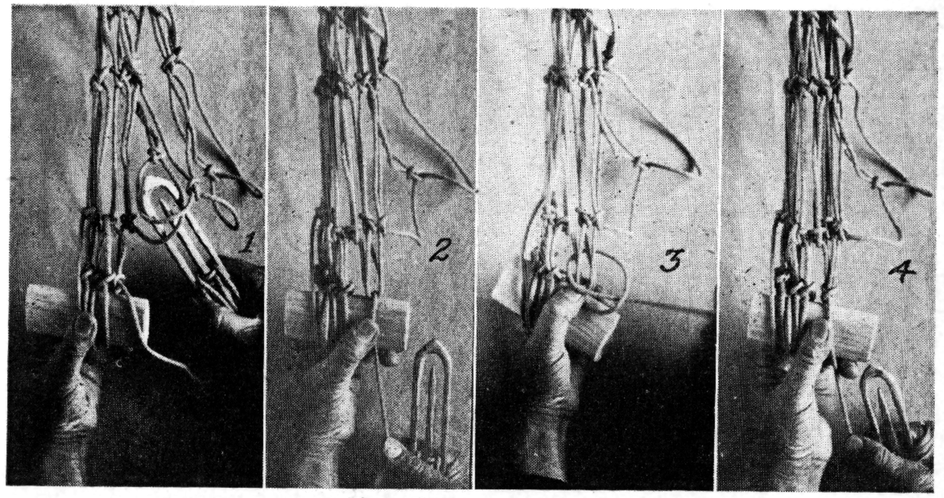


Fig. 5

Martha's Vineyard Method of Netting

Refer to Fig. 6, Cut 1 which shows a completed weaver's knot. Double length meshes are being formed, hence two turns of the cord have been taken around the mesh stick and the cord is held as indicated in Cut 2. The needle is now passed under both the cord and the mesh stick, Cut 3, and the free loop of cord between the fingers and the needle is carried up over the needle tip and held by the right hand as shown in Cut 4. It is then passed through the upper loop as indicated. The cord is carried around the needle tip, Cut 5, and passed around the little finger of the left hand, Cuts 6 and 7. The needle is pulled through the mesh as shown in Cut 6 and the cord is tightened to seat the weaver's knot on the mesh stick, Cut 7.

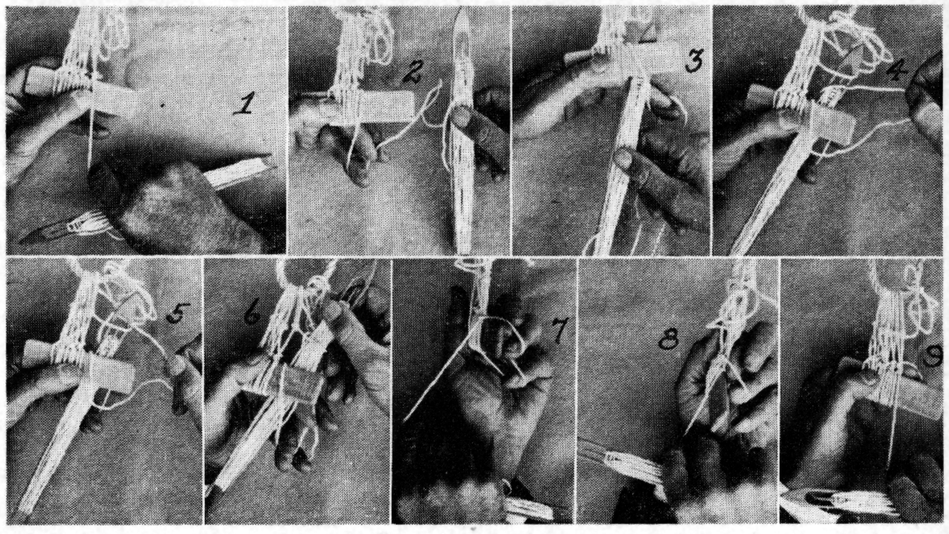


Fig. 6

It is then necessary to remove the slack in both loops. The loop on the little finger is first slipped off and the cord pulled until the slack disappears as in Cuts 7 and 8. Tension must be kept on the cord which is pulled until the last loop is removed. A finger is held in the loop to prevent distortion and insure its proper position on the mesh stick. Cuts 8 and 9.

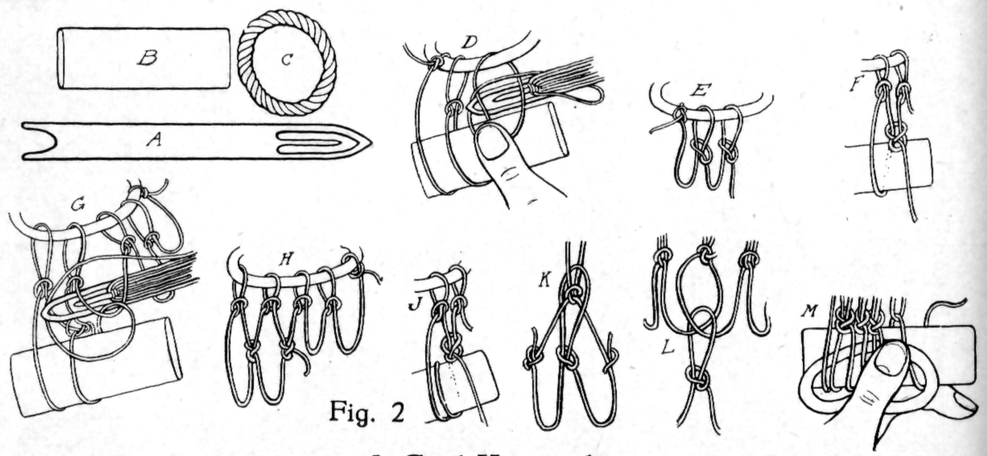


Fig. 2

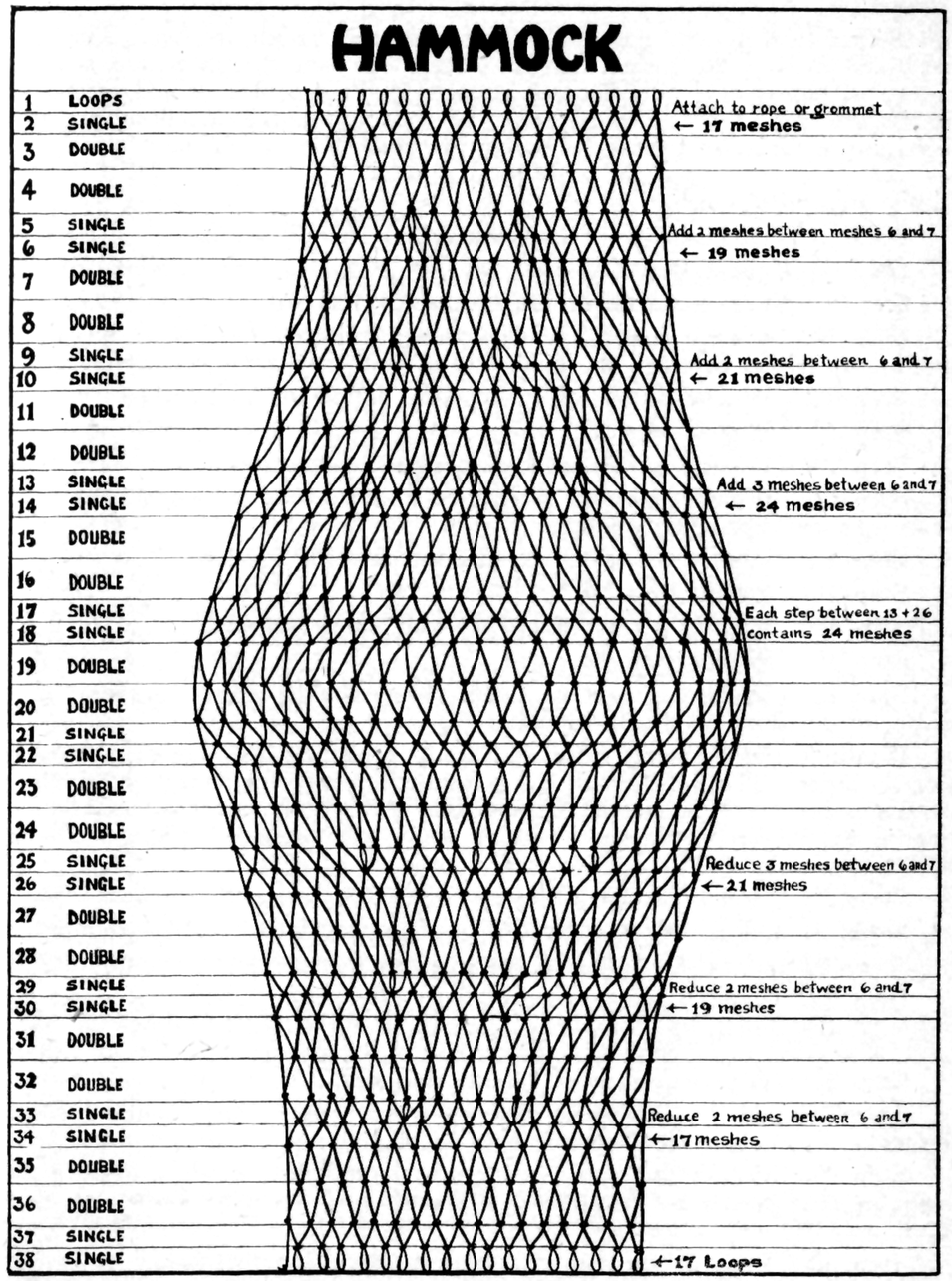
A Cord Hammock

A Cord Hammock made from the following specification may be appropriately used as porch equipment at home or in camp. It is light in weight and a very desirable addition to a camper's equipment. It may be conveniently carried in the back pack or bed roll.

The Hammock is woven with No. 16 ply cotton cord and two one-half pound balls will be required. For the Camper's style two 8′ length of $\frac{3}{8}$″ manila rope are also needed and the Porch style takes a 3′ piece of $\frac{3}{8}$″ rope for the grommets. The detail in making a grommet is shown on page 363. The start of a hammock beginning with a finished grommet is indicated in Fig. 2, above. The Camp style hammock is started through a spliced eye in identically the same manner as shown in the illustration above where a grommet is used. The other end of the rope should be whipped to prevent unraveling. This operation is described on page 369.

Construction of a Cord Hammock

Step 1. Form seventeen loops on the supporting loop or grommet as indicated in Fig. 2, Cuts D to M, page 414, and remove the mesh stick. Note that the loops are finished from left to right which brings the needle cord on the right hand side. Twist the loops from right to left. This brings the needle cord again on the left, which is the starting position for all weaving. See construction detail, page 414.



Step 2. Weave a row of seventeen, single mesh as indicated in Fig. 4, Cuts 2, 4 and 5. Again turn the work over, twisting the fabric from right to left to bring the needle cord on the left hand side.

Step 3. Weave a row of double length meshes by wrapping the cord twice around the mesh stick as described in the foregoing paragraphs. In Fig. 3, Cut 5, the uppermost of the double length mesh is clearly shown.

Step 4. Repeat step 3.

Step 5. Weave a row of seventeen single length meshes.

Step 6. Weave a row of nineteen double length meshes. The two additional meshes are inserted in the fabric between the sixth and seventh meshes as indicated in the diagram, page 415. The method of adding meshes is shown in Fig. 3, Cut 5, page 412. The position of the added meshes may be readily determined by the following principle. Count six mesh and insert the extra mesh between the sixth and seventh. See Fig. 3, Cut 4, which shows an added mesh.

Step 7. Weave a row of nineteen double length meshes.

Step 8. Repeat step 7.

Step 9. Weave a row of nineteen single meshes.

Step 10. Weave a row of twenty-one single meshes. The two extra meshes are added between the sixth and seventh as previously described.

Step 11. Weave a row of twenty-one double length meshes.

Step 12. Repeat step 11.

Step 13. Weave a row of twenty-one single meshes.

Step 14. Weave a row of twenty-four single meshes, adding the extra meshes as described in step 6.

Step 15. Weave a row of twenty-four double meshes.

Step 16. Repeat step 15.

Step 17. Weave a row of twenty-four single meshes.

Step 18. Repeat step 17.

Step 19. Weave a row of twenty-four double length meshes. This completes one-half ot the hammock.

Continue the weaving from this point, repeating the nineteen steps in reverse order. The fabric will be continued twenty-four meshes in width for five more mesh rows, then reduced to twenty-one meshes, and finally tapered to the seventeen mesh width which corresponds to the width at the starting point.

Step 20. Weave a row of twenty-four double length meshes.

Steps 21 and 22. Weave two rows of twenty-four single length meshes.

Steps 23 and 24. Weave two rows of twenty-four double length meshes.

Step 25. Weave one row of twenty-one single meshes. Reduce the width at this point by combining the sixth and seventh meshes at each point. See paragraph, page 412, on method of decreasing the width of fabric.

Step 26. Weave a row of twenty-one single length meshes.

Steps 27 and 28. Weave two rows of twenty-one double length meshes.

Step 29. Weave one row of nineteen single length meshes. Reduce the width at two points by combining the sixth and seventh meshes at each point.

Step 30. Weave one row of nineteen single length meshes.

Steps 31 and 32. Weave two rows of nineteen double length meshes.

Step 33. Weave one row of seventeen single length meshes. Reduce the width at two points by combining the sixth and seventh meshes at each point.

Step 34. Weave one row of seventeen single length meshes.

Steps 35 and 36. Weave two rows of double length meshes.

Step 37. Weave one row of seventeen single length meshes.

Step 38. This step completes the hammock and the tie rope or grommet is attached to the fabric during the construction of the last row of seventeen single length meshes. Weave each mesh around the rope which forms the eye splice or grommet. This is accomplished by holding the rope against the mesh stick. As the mesh is formed the needle passes through the opening in the rope. When the mesh stick is removed each mesh passes through the rope loop or grommet.

Hammock Making—*Alternate Method

The procedure is to begin netting at the middle point. A specified number of loops are netted on a temporary rope support. The hammock width is tapered by the **reduction method of doubling the meshes** described on page 412. One half of the hammock is netted from the center to the end. The supporting rope is passed through the last row of single meshes and an eye-splice or bowline may be used to join the rope to the hammock. See details, page 372 and 382. Two temporary rows of single mesh are used to start the netting. Remove these to eliminate all slip knots by unraveling the twine and reloading the netting needle with the twine removed. Repeat the steps indicated for the completion of the other half of the hammock.

A hammock suitable for an adult person may be made by either specification from one pound of size No. 24 soft laid seine twine. Use twenty feet of 3/8" Manila rope for the support. The recommended width of mesh sticks are for Hammock A three inches, and Hammock B four inches.

A child's hammock may be made by either specification, from one-half pound of size No. 21 soft laid seine twine. Use a two inch wide mesh stick for Hammock A and a three inch one for Hammock B.

A doll hammock may be made from a one quarter pound of size No. 9 soft laid seine twine. Use Hammock-B specifications and a mesh stick one and one half inches in width.

Hammock Specifications

STYLE A

Step	Netting Procedure
1.	31 Loops. Middle of Hammock.
2.	6 Rows. Single mesh.
3.	I: Reducing row—(5) single, (1) double, (5) single, (1) double, (2) single, (1) double, (5) single, (1) double, (5) single.
4.	4 Rows. Single mesh.
5.	II: Reducing row—(4) single, (1) double, (4) single, (1) double, (2) single, (1) double, (4) single, (1) double, (4) single.
6.	4 Rows. Single mesh.
7.	III: Reducing row—(3) single, (1) double, (3) single, (1) double, (2) single, (1) double, (3) single, (1) double, (3) single.
8.	2 Rows. Single mesh.
9.	Pass rope support through last row, single mesh. Form eyesplice. Return to center of hammock. Remove 2 rows, single mesh. Repeat steps 2 to 9.

STYLE B

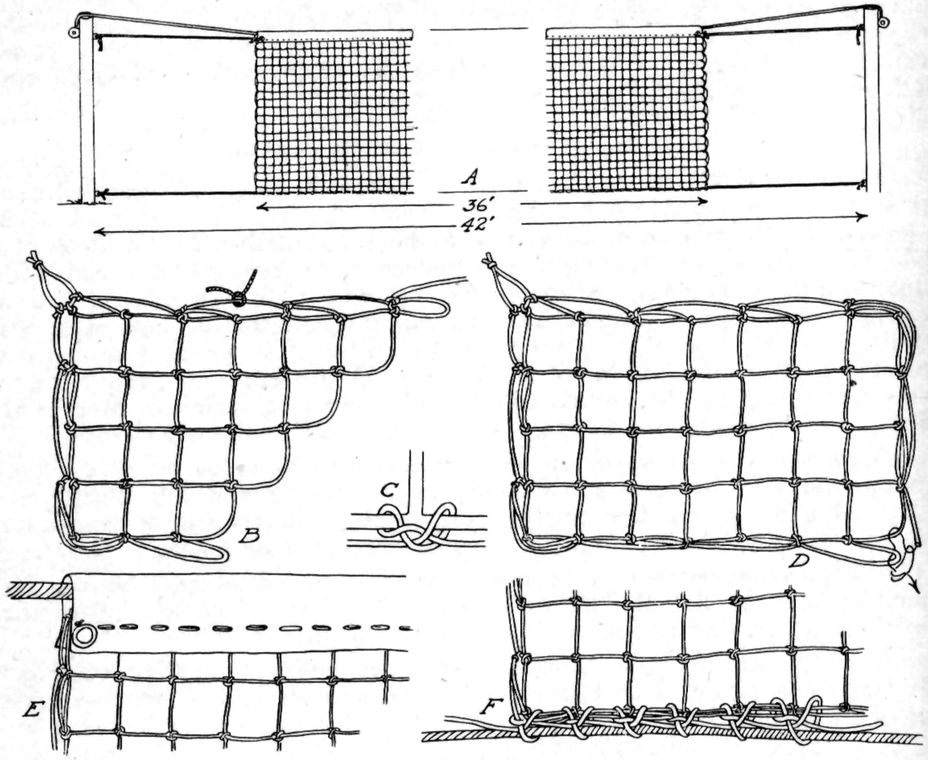
Step	Netting Procedure
1.	21 Loops. Middle of Hammock.
2.	4 Rows. Single mesh.
3.	I: Reducing row—(3) single, (1) double, (3) single, (2) double, (3) single, (1) double, (3) single.
4.	2 Rows. Single mesh.
5.	II: Reducing row—(6) single, (2) double, (6) single.
6.	2 Rows. Single mesh.
7.	III. Reducing row.
8.	4 Rows. Single mesh.
9.	Pass rope support through last row. Single mesh. Form eyesplice. Return to center of hammock. Remove 2 rows. Single mesh. Repeat steps 2 to 9.

*Hammock Detail furnished by Mr. Walker Ingraham, Pleasantville, N. Y.

TENNIS NET CONSTRUCTION

The technic of netting or cord weaving is given on pages 411 to 414. The construction of a standard double court tennis net illustrated by Sketch A follows. The dimensions of a net to fit a standard size court in terms of the netting unit or mesh (1½″ square) is 280 meshes long by 20 meshes wide.

This net is suspended by ropes between posts spaced 42 feet apart. The posts are 3′ 6″ above ground and the top rope may be carried over the top of each post. Sufficient tension is placed on the rope to raise the middle point of the net three feet above the ground. A hold down loop of canvas not to exceed 2″ in width may be used to control this height.

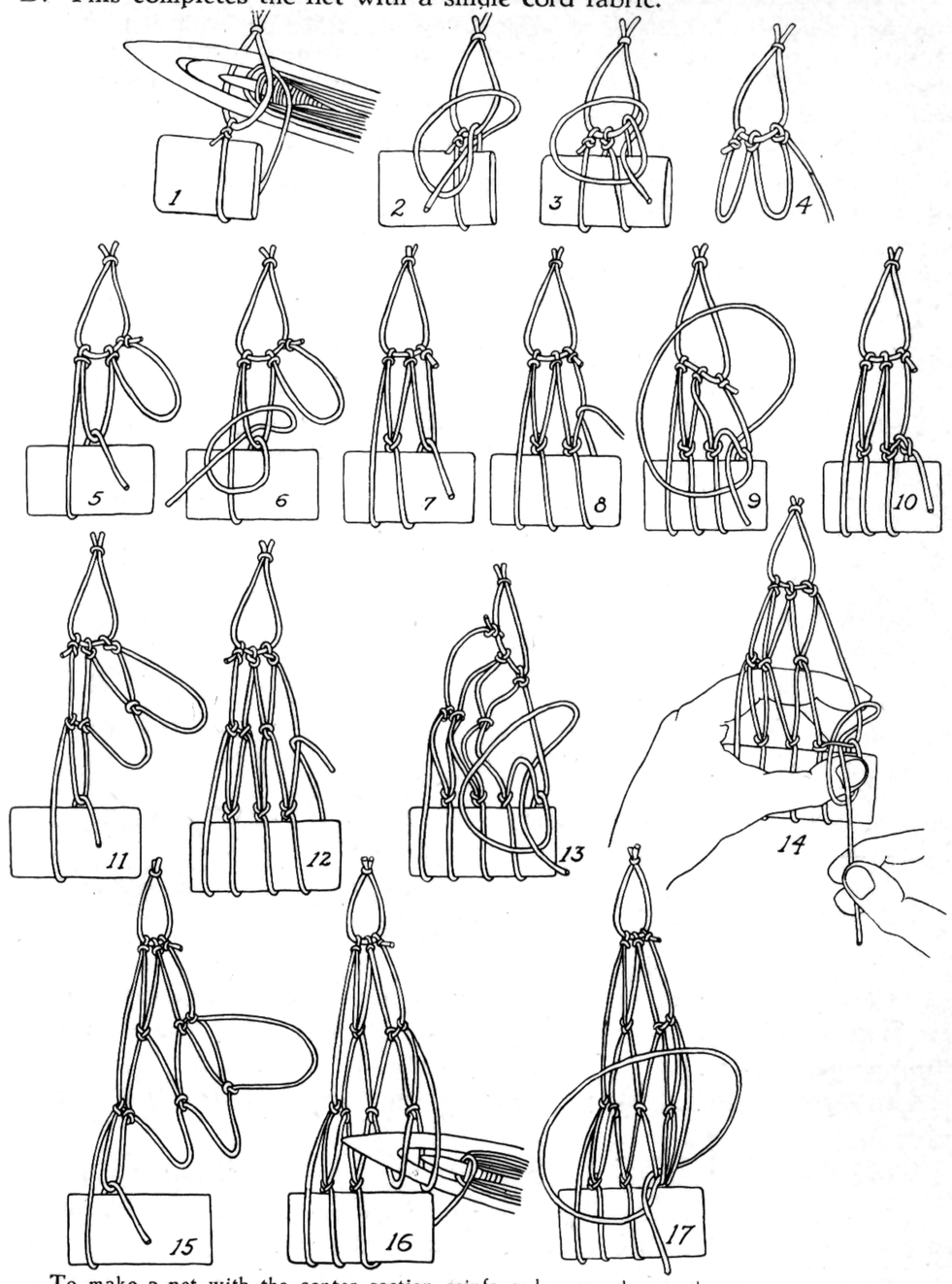


Start the netting on a foundation loop as indicated in Sketch B shown in the upper left hand corner. The completed rectangle is shown in Sketch D which also shows the method of closing the last mesh, lower right hand corner of Sketch D. The net is attached to the suspension ropes as indicated in Sketch F, using a cord and the seizing knot (Millers Sack Knot) shown in Sketch C. The upper edge is covered with a piece of canvas as indicated by Sketch E, either machine or hand stitched.

The netting needle, mesh stick and foundation loop are shown in Sketch 1. Net two loops on the foundation loop, see Sketch 4, as indicated by Sketches 2 and 3. Sketch 5 shows the foundation loop turned over. Continue netting as indicated by Sketches 6 and 7. Sketch 8 shows how additional loops may be formed by going through the same loop twice. Sketches 9 and 10 indicate the process known as **increasing.** Turn the foundation loop over, see Sketch 11, and continue netting as shown by Sketches 12 and 13. Sketch 14 shows the manipulation in forming the knot on top of the mesh stick.

Continue this process until a 20 mesh width is obtained. Maintain width by keeping the number of meshes equal in each row by **decreasing the length one mesh** (by netting the last two loops together) as indicated in Sketches 16

and 17. On the next row increase by one mesh as shown in Sketches 13 and 14. Repeat and alternate this procedure. Continue this process for 280 meshes, then decrease at the end of each row to fill out the corner. See Sketches B and D. This completes the net with a single cord fabric.



To make a net with the center section reinforced proceed as follows:

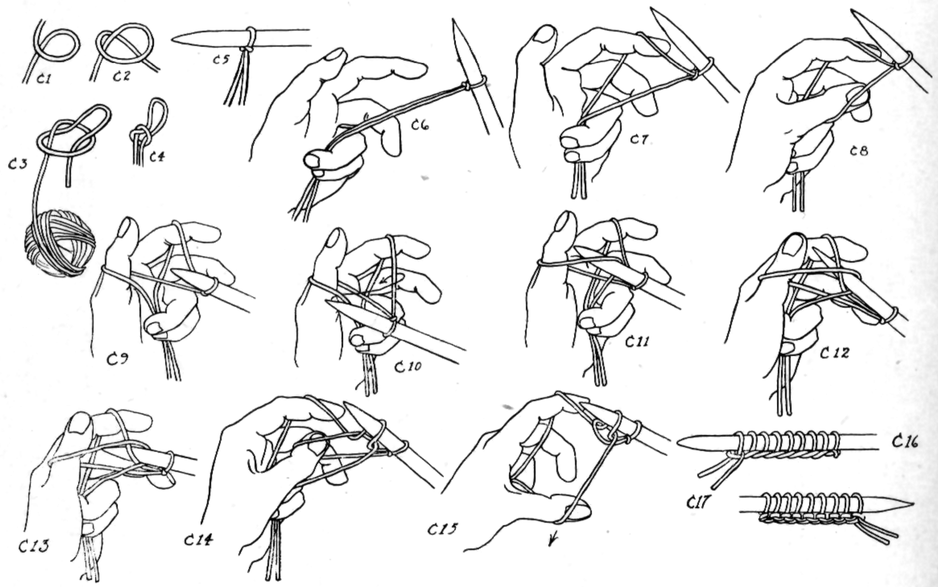
Net a rectangular area 93 meshes long by 20 meshes wide, and complete the corner as described above. Reload the netting needle with twine from two balls and net a rectangular area 94 meshes long and 20 meshes wide. Complete the corner by decreasing one mesh at the end of each row. Reload the netting needle with a single twine and net another rectangular area 93 meshes long and 20 meshes wide. Finish out corner. Attach the net to the suspension ropes as indicated in Sketches E and F.

Material—4 Balls No. 21 Seine Twine for Single Net (5 Balls for reinforced center); 1 piece of canvas 4″ wide, 36′ long; 90 feet ⅜″ rope; 10 ft. ¼″ rope.

Knitting Procedure

Two types of procedures for working with yarn, namely weaving and knitting, suggest themselves as appropriate material for inclusion in this chapter on rope and cord. Since weaving is treated under a separate chapter: Navaho Indian weaving, Spanish Chimayo blanket making, we shall here restrict our presentation to an analysis of the elements of knitting, and endeavor to visualize the basic principles involved in the process.

In Macrame or square knot work, page 405, and netting, page 411, knots are tied as the work progresses, whereas in knitting, a series of interlocking loops are formed. The construction of this loop work is accomplished by the use of two needles or a hook. The formation of these loops (stitches—the usual common name) requires a manual skill in handling needles, also maintaining a proper tension on the yarn as the knitting continues.



Casting On. This initial step, as the name implies, is the starting point for knitting and consists of forming a series of loops or stitches on one of the knitting needles.

I. Form an overhand knot as indicated in Sketches C-1, C-2, C-3, C-4, near the end of a strand of yarn.

Into the loop shown in C-4 insert the end of one needle as at C-5.

II. Grasp the two strands of the yarn with the third and fourth fingers of the left hand. Grasp the needle with the right hand.

III. Separate the two strands of yarn with the forefinger of the left hand, C-7. Into this opening also place the thumb. See Sketch 8.

IV. Pull the yarn passing over the thumb and forefinger into the position indicated by Sketch 9. Meanwhile keep sufficient tension on the two yarn strand with the two fingers shown covering the yarn in C-7 and C-9.

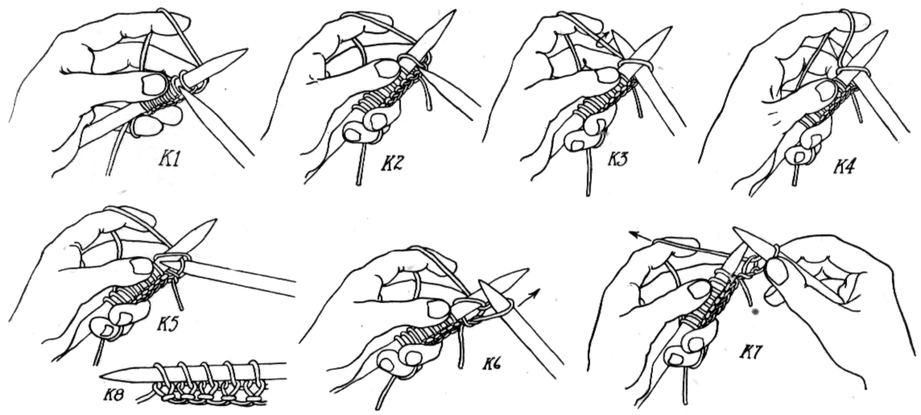
V. Carry the strand of yarn passing around the thumb across the yarn supported by the forefinger as indicated by the arrow in Sketch 10. See this process step by step in Sketches C-11, C-12, C-13.

VI. Form a loop as indicated in Sketch C-14. Note the tension in the yarn strand passing across the first finger, holds the newly formed loop close to the needle and keeps the loop small. Also note in C-14 that the loop over the thumb is about to be slipped off.

VII. Remove the thumb from the loop C-14 and exert sufficient downward pressure on the yarn strand—see C-15—to pull the yarn snug around the base of the new loop formed on the needle. Also note the tension is still kept on the two-yarn strands by the pressure of the third and fourth fingers of the left hand. The thumb and forefingers are both inside the two yarn strands as shown in Sketch 8. Repeat steps I to VII.

After the desired number of loops have been cast on the right hand needle—see appearance of needle, Sketch C-16—transfer the needle to the left hand. Sketch C-17 shows the appearance of the reverse side of the loops.

To Knit: This step consists of forming a new series of loops which pass through those formed on the left hand needle. Two or more methods are used by those who knit to accomplish this process. The one shown here is the speed method and since the tension on yarn is controlled by the left hand, it is considered a somewhat difficult technic to master. The other method, detailed on page 423, accomplishes the same results, but the tension is controlled by the right hand. This involves an arm motion instead of a finger motion and is consequently the slower of the two methods.



I. Grasp the needle in the left hand, see Sketch K-1. Note the yarn strand passes over the fore (first) finger and around the little (fourth) finger to control tension. The second and third fingers should hold the needle and keep the "cast on" loops in position.

II. Place the point of the right hand needle between the two loops nearest the end of the left hand needle. Sketch K-1.

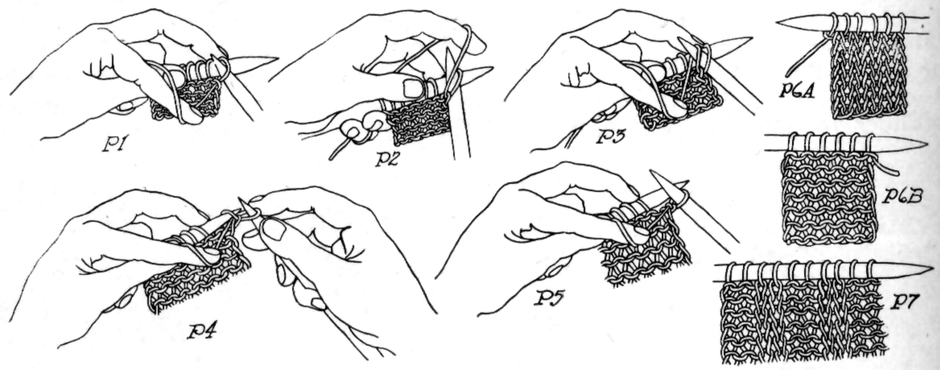
III. Slide the end loop along toward the point of the left hand needle, Sketch K-2, until it is loose enough to receive the point of the right hand needle.

IV. Pass the point of the right hand needle through this loop and under the tip of the left hand needle, Sketch K-3. Carry the tip of the right hand needle under the yarn as indicated by the arrow, Sketch K-3.

V. Lift the strand of yarn up through the enlarged loop on the left hand needle, see Sketch K-5, and relax the tension by moving the forefinger (left hand) toward the needle as the new loop is formed on the right hand needle.

VI. Again place tension on the newly formed loop by moving the forefinger (left hand) away from the needles, see direction of arrow, Sketch K-7, also slide the new loop off the end of the left hand needle while the yarn strand is under tension. Slide the loops along the left hand needle and repeat as shown in Sketches I to VI. Repeat until all the stitches have been knit or placed on the right hand needle. When the right hand needle contains all the loops or stitches again transfer it to the left hand and proceed as directed. Sketch K-8 indicates the appearance of the knit stitch. This sketch shows a stitch very loosely done. The exaggeration is purposely made to visualize the structural detail.

To Purl: This step consists of forming a new row of loops which pass through the proceeding row. Inasmuch as the loops are taken off the left hand needle and accumulated on the right hand needle, this much of the procedure is similar to the proceeding step. However, the fabric is reversed by transferring the needle from the right to the left hand. Since it is the plan to produce a stitch similar to the knit stitch when working from the lower or under side of the fabric, the looping procedure is accomplished by carrying **the loop down,** through the fabric, and consequently the yarn must be in front of the work.



I. Grasp the needle with the left hand. Thumb and second fingers hold the work and needle. The forefinger keeps the tension on the yarn which passes in front of the work, see Sketch P-1.

II. Insert the tip of needle (right hand) into the last loop (on left hand needle) from below, see Sketch P-1.

III. Carry the yarn over and around the tip of the right hand needle as indicated by Sketches P-2 and P-3.

IV. Hold the last loop on left hand needle is passed through the loop.

V. Secure the newly made loop with the forefinger (right hand), Sketch P-4, and slide the preceding loop off the left hand needle as indicated by Sketch P-4.

VI. Secure the newly formed loop on the right hand needle by keeping tension on yarn with the forefinger (left hand) as indicated in Sketch P-5. Repeat.

The appearance of a knit fabric—stitches enlarged and loosely knit—is indicated in Sketch P-6, A and B. Sketch A shows the knitted stitch. Sketch B shows the purled stitch. This specification is: knit one row; purl one row; in the symbols of abbreviated instruction—

K — knit P — purl * . . . * — Repeat

This specification—cast on the desired number of stitches on a needle, K-1 row, P-1 row, for the required length, is known as the Stockingnette stitch.

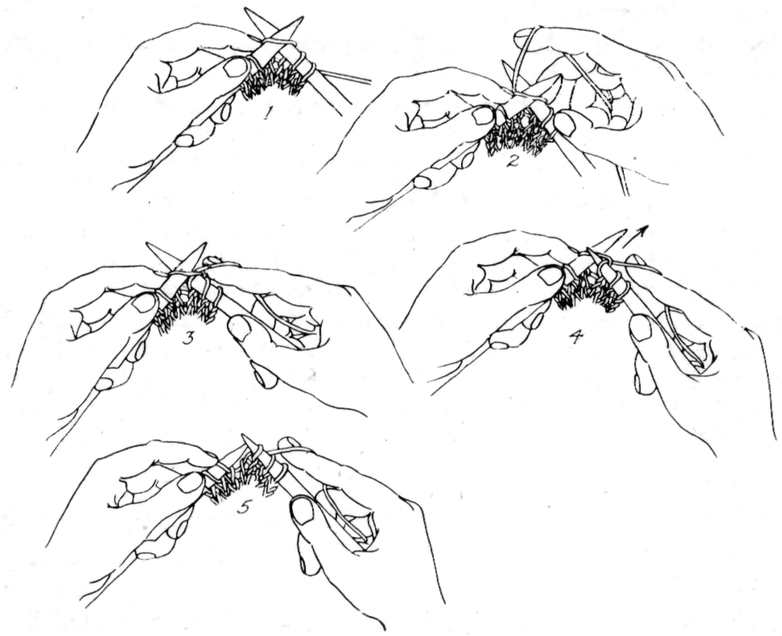
KNITTING PROCEDURE

Alternate Method—Right Hand Tension Control

To Knit:

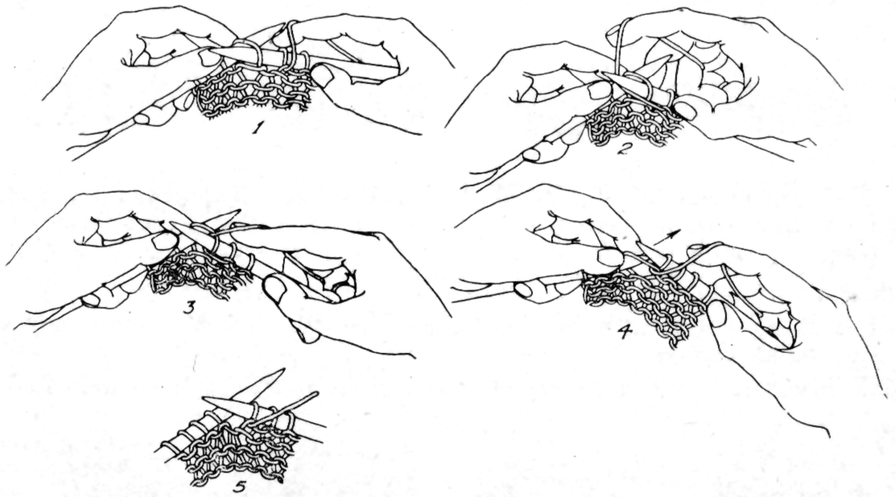
I. Insert right hand needle in loop on left hand needle from front to back as shown in Sketch 1.

II. Grasp the yarn strand with the third and fourth fingers of the right hand after carrying it over the forefinger under tension. Pass the yarn over the point of the right hand needle as indicated in Sketch 2.



III. Draw the yarn into position on the right hand needle as shown in Sketch 3.

IV. Exert pressure on the yarn strand with the forefinger (right hand) in the direction indicated by the arrow. See Sketch 4. Draw the right



hand needle out from under the left hand needle (Sketch 3) and lift the loop on point of right hand needle (Sketch 4) up through the loop on left

hand needle. Maintain tension on yarn strand and slip the loop off of the left hand needle. Push on the loop with the forefinger (left hand) to facilitate its removal. Meanwhile grasp the fabric and needle between the thumb, second and third fingers to prevent slipping more than the one loop off when completing the knitting stitch. Sketch 5 shows the knitted stitch and loop transferred to the right hand needle. Repeat.

To Purl:

I. Insert right hand needle in loop on left hand needle from both to front as shown in Sketch 1.

II. Pass the strand of yarn under tension over the point of the right hand needle as indicated in Sketch 2.

III. Carry the strand of yarn (under tension) down through the loop of the left hand needle as indicated in Sketch 3.

IV. Slip the loop off the left hand needle as indicated in Sketch 4.

V. Sketch 5 shows the purl stitch completed. Repeat.

The method of knitting used in socks and stockings is to put the desired number of stitches on a needle and divide them into 3 or 4 needles joined into a ring. Knit round and round, using an additional needle.

Another specification—using the same stitches described above—K-2, P-2, across, that is, knit two and purl two stitches alternately—gives a fabric similar in appearance to that indicated by Sketch P-7. The stitch with the horizontal lines are knit while the ones with vertical lines are the purled stitches.

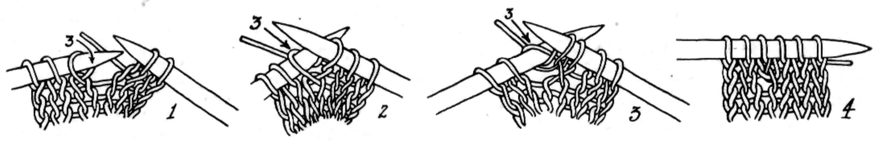
To Increase:

This term is applied to the process of placing additional loops or stitches in the knit fabric. The procedure for one method follows:

Method A—

I. Knit one stitch through the back of loop (3) as indicated by Sketch 1-A. Sketch 2-A shows the loop drawn through loop (3) from below or the back.

II. Permit loop 3 to remain on the left hand needle, and knit one more stitch through loop 3 through the front this time as indicated in Sketch 3-A. Now slip loop (3) off the left hand needle.

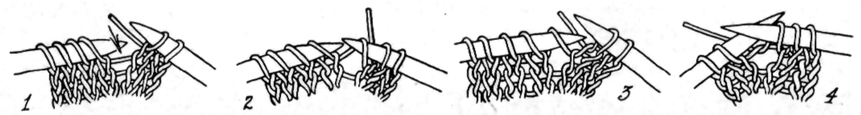


The appearance of the fabric which has been lengthened by adding stitches is indicated in Sketch 4-A. It will be noted that a hole appears in the work.

Method B—

I. Pick up a loop in between stitches. See Sketch 1-B. Arrow indicates the loop to be chosen.

II. Insert right hand needle under yarn from the back as indicated in



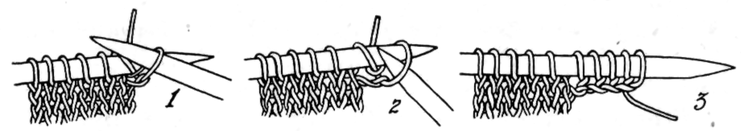
Sketch 2-B. Lift this loop over the end of the left hand needle as shown in place as indicated in Sketch 3-B.

III. Knit a stitch through this loop in the usual manner. Sketch 4-B shows the appearance of the stitch knitted through the loop.

Adding Stitches: This process of forming shapes from the rectangular fabric is similar to a chain stitch and produced as described below.

I. Knit the first stitch as indicated by Sketch 1-AS without sliding it off the left hand needle.

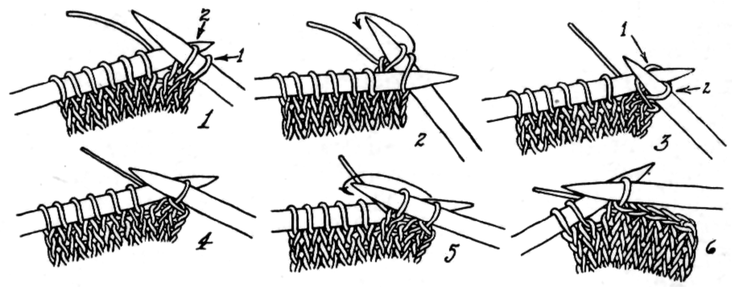
II. Remove the stitch from the right hand needle and place it on the left hand needle as indicated by Sketch 2-AS.



III. Repeat for the desired number of stitches required for the additional width. Sketch 3-AS shows the appearance of the additional stitches on the left hand needle.

To Bind Off, in the terminology of knitting, is a term used for removing the needles upon completion of a knitted article. The process is sometimes referred to as casting off. In the process the stitches must be secured. The usual procedure is detailed below. The knitted fabric is on the left hand needle as indicated in Sketch 1. The tension should be very loose, and the loops large.

I. Insert the right hand needle into the end loop and knit two stitches. See Sketch 1.



II. Pass the left hand needle through the end loop on the right hand needle. See Sketch 2.

III. Lift the first loop over it as indicated by the arrow, Sketch 2.

IV. Bring the second loop up through the first loop as shown in Sketch 3 and slip loop (1) off the end of the left hand needle. Sketch 4 shows the appearance of this step completed.

V. Knit another stitch. Pass the first loop over the second as indicated in Sketches 2 and 3, and slip the knitted loop off left hand needle. See Sketch 5.

VI. Continue this procedure until one loop only remains. Break off the yarn and pass it through the last stitch. Sketch 6 shows the appearance of the edge produced by this process.

HORSEHAIR HANDICRAFT

The Art of working horsehair like leather thong plaiting was known and practiced by the Cowboys on the ranches in the Southwest. In the Springtime after the cow ponies were brought in from the winter range they were considered unfit to use until their manes and tails were combed out and all the long hair removed. This hair was bundled into gunny sacks and saved usually until winter when long evenings afforded opportunity for the making of new equipment. Cinches, Ropes, Hackamores, Bridle Reins, Quirts, occasionally a Hair Saddle Blanket, Hatbands and Belts were among the articles to be made.

There are four general types of horse hair construction:

(1) **Twisted strand hairwork** in which the hair strands are made into rope. Size is controlled by adding strands.

(2) **Plaited Strand Hairwork** of four, eight, twelve and sixteen plaited strands are laid side by side and sewn together through the edges to form a flat strap.

(3) **Halfhitch Hairwork** is built around a core by throwing half-hitches with a strand of hair, around a piece of twine that is wound about the core as the work progresses. After the work is finished the core may be removed if desired and the hair tube flattened out.

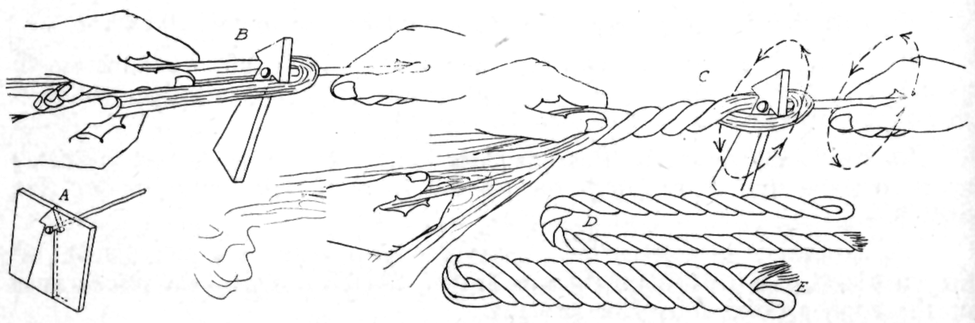
(4) **Woven Hairwork** is produced by carrying strands of horsehair as a warp, and weaving with a two strand weft. See Sketch V, Fig. 5, page 430.

TWISTED HAIRWORK

A simple and effective twisting tool is made out of a piece of wood as shown below. The arrow shaped board is placed upon a large spike which passes through a hole near the arrow barb. The nail serves as a handle also an axis for the board which is caused to rotate as indicated in sketch C.

A wisp of hair is placed over the arrow barb as shown in sketch B, and the arrow is rotated as shown in sketch C. The operation of the twister backs away from the person who holds the twisting strand and feeds the hair into the strand as needed.

The length of the single twisted strand will be four times the length of the finished rope. The single strand is doubled as shown in sketch D and the strands will coil together into a double strand rope. The rope is doubled again as shown in sketch E. Terminal Turkshead knots may be tied on the right hand end as shown on page 107. The left hand end of the strand, sketch E, does not require a terminal knot unless the strands are cut, since the strands double back upon themselves and are held tightly in place by the tendency to twist together.



HORSEHAIR

Plaited Strand Hairwork

Horsehair strands to be plaited should be prepared from hair of uniform length. Five to ten horsehairs are placed side by side and an overhand knot is tied at one end. A slight twist, about three turns, will make the hair into a strand. Then tie an overhand knot at the other end.

Plaited strands of horsehair in multiples of 4 will yield a finished strand that has a square cross section. Several strands when placed side by side and stitched together will give a flat strap.

See Fig. 1, sketch Q; Fig. 2, sketch J; Fig. 3, sketches E, H, M, N; Fig. 4. sketches C and D; also the belts and hatbands in photograph, page 437.

Many and varied are the designs produced by using black and white (grey) horsehair or other contrasting colors in the plait strand. The color and arrangement of the hair strands, determines the pattern in the plaited strand. These strands may then be used to parallel other strands in such a position that the combined pattern results in the design element of the finished work.

See Fig. 1, Sketch Q; also Fig. 2 and Fig. 3, page 428; Fig. 4, page 429; also the belts and hatbands in photograph, page 437.

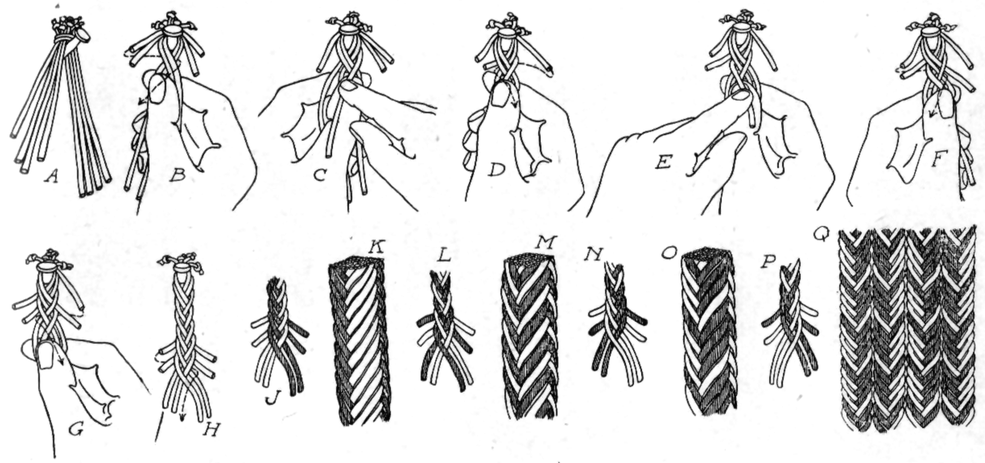


Fig. 1

Eight Plait

The method of plaiting eight strands of hair is shown in Fig. 1, sketches A to G. For convenience in starting the plait, the strands are separated into two groups of four each and supported as indicated in sketch A.

Cross the two left hand strands over the two right hand ones as shown in sketch B. The highest thong on the left is brought around behind the strand, under the two right hand strands, and over two as indicated in sketch B, and in place in sketch C. Change hands and repeat the operation from right to left, as shown in sketches D and E. The principle then for eight plait is as follows: Bring highest strand around behind the plait, under two and over two. Change hands and repeat, using the highest strand on the opposite side of the plait.

Eight Plait Designs

In Fig. 1, sketches K, M, O, three patterns are presented which appear in a strand of eight plait when following the strand arrangement shown in sketches J, L, N.

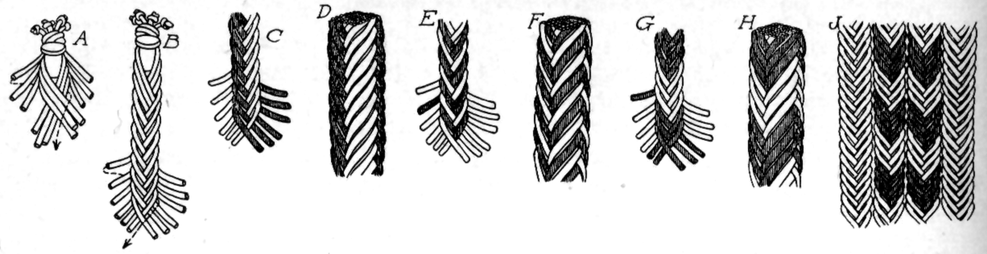


Fig 2

Twelve Plait

The procedure in plaiting twelve strands is similar to that described for eight strands. The start is made by crossing the three left hand strands over the three right hand strands, Fig. 2, sketch A. The principle for twelve plait follows: Bring the highest strand around behind the plait, under three and over three. Change hands and repeat, using the highest strand on the opposite side of the plait.

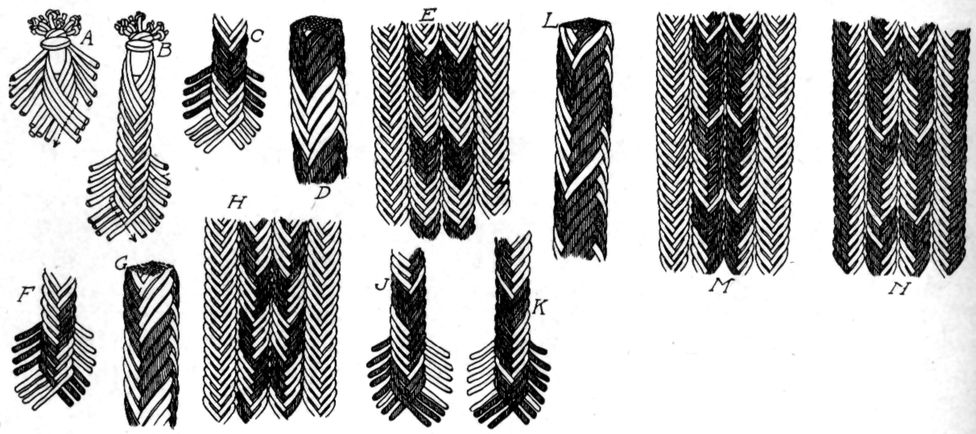


Fig. 3

Sixteen Plait

The sixteen plait is produced in a similar manner to the eight and twelve plait. Start the plait by crossing four left hand strands over the four right hand strands, Fig. 3, Sketch A. The principle for plaiting sixteen strands follows: Bring the highest strand around behind the plait under four and over four. Change hands and repeat using the highest strand on the opposite side of the plait.

Sixteen Plait Designs

In Fig. 3, sketches D, G, L, three patterns are presented which appear in a strand of sixteen plait when following the arrangement shown in sketches C, F, J. Sketch K shows the same pattern as that appearing in sketch J, only reversed. In the assembly of plaited strands, sketches H, M, and N, the left and right hand patterns combine to produce a design in the assembled strap.

Strap Assembly

In Fig. 4, sketches A, B, E, and F, will be found a method commonly used in the assembly of a strap from plaited strands. Sketches A and B show the method of making the round end of a strap when it is to be used for a belt tongue. In using an equal number of plaited strands the first strand is folded back along itself as shown in sketch A. The next strand is laid along side of the first strand and passes around the end and back on the opposite side of the doubled strand. Other strands may be added to increase the width in the same manner.

In case the desired width of an assembled strap requires an odd number of plaited strands, the arrangement shown in sketch B is frequently used.

The parallel plaited strands which make up the strap are held in place by a thread shown in Fig. 4, sketch E. This thread is sewed thru all strands, with stitches the length of which are about equal to the width of a single plaited strand from which the strap is made.

The end of the strap shown in sketch E is made rigid by seizing each strand separately with thread, about two turns each, and then seizing all strands with a few turns of thread just back of the seizing threads on the separate strands.

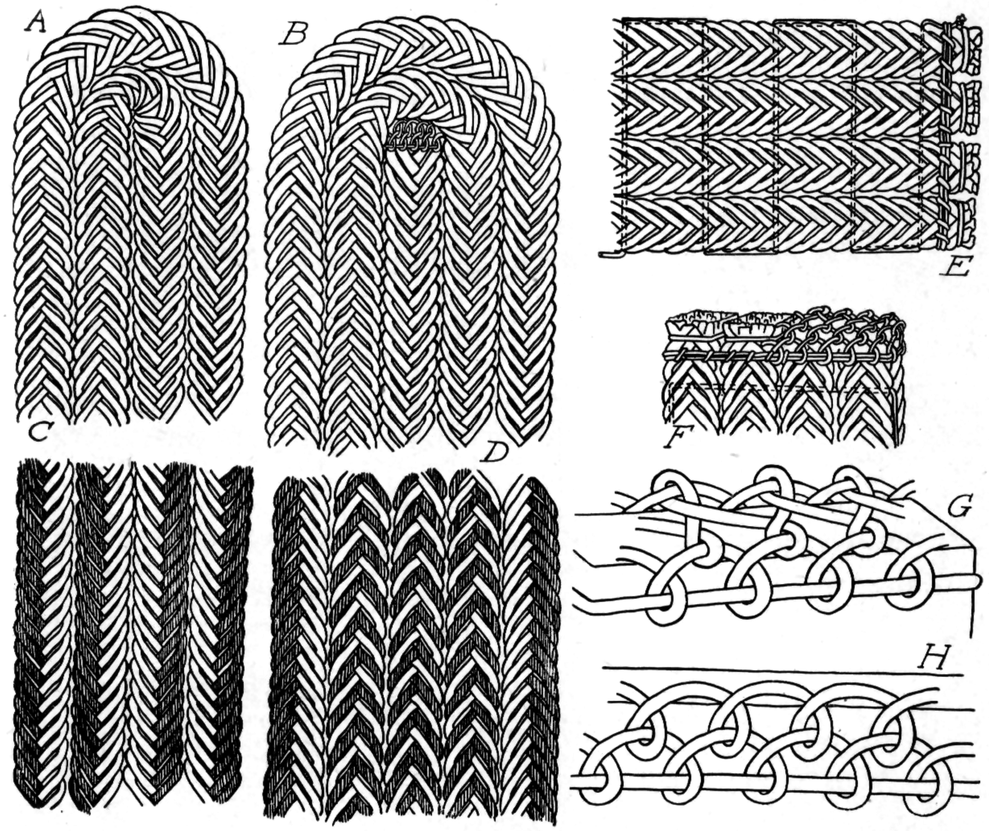


Fig. 4

Sliding Knot and Tassel Construction

Adjustable fastenings for Horsehair Hatbands, Lanyards and other articles, are similar in construction to those used on leather. Single or double plaited strands may be terminated in a tassel as indicated in sketches A to S, Fig. 5. The end of the plaited strands are seized with thread as shown in sketches B and C. A Hair Tassel of short lengths (5″ to 6″) of hair are placed around the ends of the strands as shown in sketch D. The seizing thread is carried around the tassel hair as shown in sketch E. The upper ends of the tassel hair are folded back over the seizing thread as shown in sketch F, and these are seized in place as shown in sketch G. The

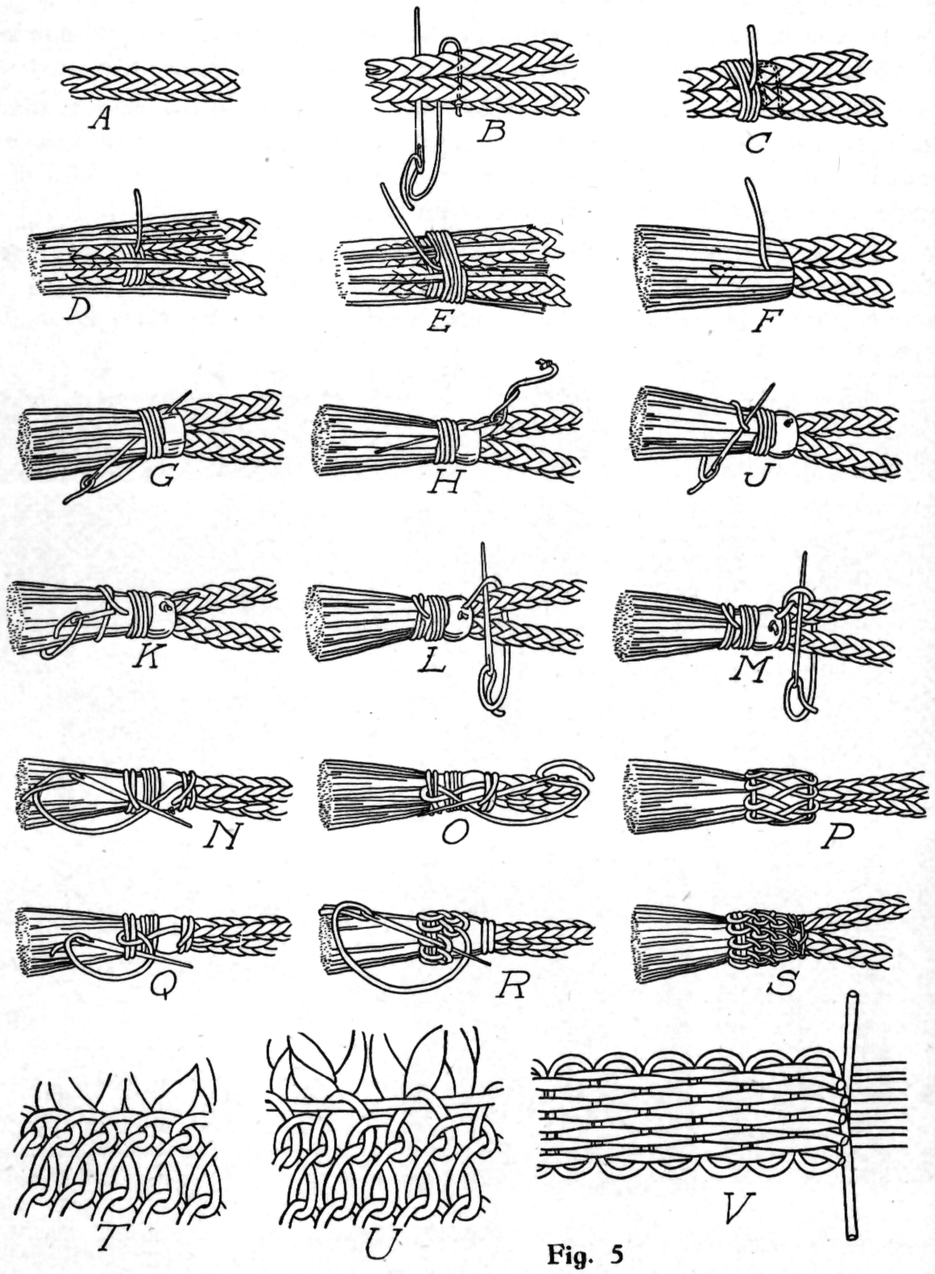


Fig. 5

needle is now threaded with a strand of horsehair, and the end is secured as shown in sketches H and J. Two turns of horsehair are half hitched on each side of the seizing thread as shown by the sketches K, L, and M. These bands of horsehair are used in forming the covering which conceals the ends of the tassel. Two styles of tassel end coverings are shown in sketches P and S. The former is made as indicated in sketches N and O. This type of covering is well adapted to tassels of small dimensions, and for best appearance the length should be equal to the diameter of the covered tassel.

The tassel covering shown in sketch S is built up of several rows of half hitches, woven as shown in sketch R, also in the larger detail, sketches T and V. The half hitch covering in sketch U is terminated by securing the upper seizing strand with the last row of half hitch work. In sketch T, no seizing strand is used and the last row of half hitch work completes the covering.

Woven Horsehair

Woven strands of horsehair are made up as shown in sketch V. The ten warp strands are divided equally, and the two weft strands are passed thru the warp strands from opposite directions, the warp is reversed and the operation is repeated. The weaving is ended as shown in Fig. 4, sketch F, and the half hitch covering is applied to conceal the ends of the warp strands.

Half Hitch Work

Horsehair workers who make tubular belts and insets for leather belts employ a technic known as **half hitch work.** Two types of hitches, a **front hitch** and a **back hitch** are used by these craftsmen.

The fabric is constructed upon a foundation cord, usually a double cord which is wound upon a mandrel or core made of wood.

A suitable support and tension control device is suggested by Sketch A. Two balls of twine (size No. 15, Seine Twine is commonly used) are shown. From the centers of each ball, the cord is fed under tension through the double hook support to the wooden mandrel or dowel rod. This rod should be slightly tapered, ranging from 5/8″ diameter (left end) to 9/16″. This slight taper facilitates the removal of the hair work from the rod. The two cords are attached to the dowel rod, a suitable method is suggested by sketches B and C.

Horse hair strands made from 25″ to 28″ length hair (8 to 10 hairs each) are attached to the foundation cords by the device known as a lark's head, shown in Sketch D. See page 377 for construction of the lark's head.

The ends are purposely kept unequal in length, to facilitate splicing in additional hair at intervals. This practice avoids more than one joint at any point which effectively conceals all splices. Narrow Horsehair insets for leather belts and wrist bands, etc., are made in pairs on the mandrel. Later they are separated by cutting the foundation cord between the two pieces of fabric. See Sketch 13.

Half Hitching Procedure

Hold the wooden mandrel in the left hand as indicated in Sketch E. The chair, tension hook and mandrel, arrangement shown in Sketch A is recommended. Tension is placed on the foundation cords by pulling on the mandrel with the left hand.

The strand of horsehair, Sketch E, shown at the lower edge of the mandrel is carried around the foundation cords and under itself. This method of looping strands of horsehair forms a **front hitch** mentioned above.

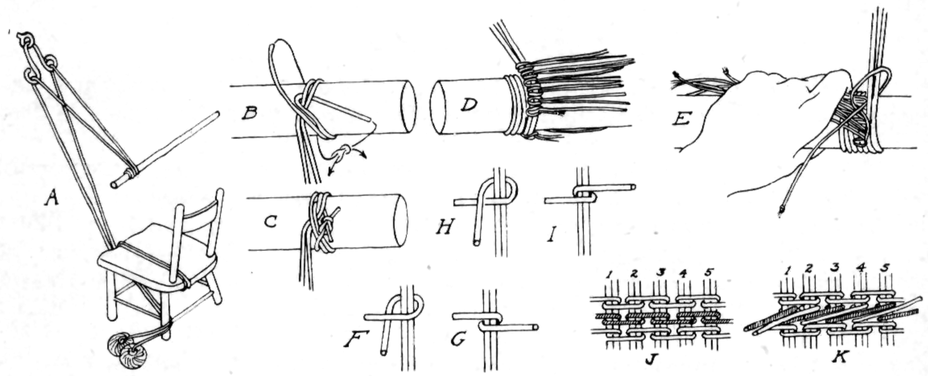
Refer to Sketch F, which indicates the mechanical structure of this element, the **front hitch,** and note that the free end of the strand is carried around the foundation cord **and under itself.** Sketch G shows the same element portrayed by diagram. This semi-perspective drawing has been used to visualize the technic of design building which appears in Sketches O to X.

Sketch H shows the structure of the **back hitch.** It is to be noted that the free end of the strand is carried around the foundation cord and **over itself.**

The principle of half hitching may be restated as follows:

1. The free end of the strand (see Sketches F and G) emerges below or in front of the loop, around the foundation cord in the **front hitch.**

2. The free end of the strand, see Sketches H and I, emerges above or back of the loop, around the foundation cord in the **back hitch.**



It is suggested that the beginner learn the half stitch technic, by making a border or selvage pattern—at first and later follow the construction of a design element as detailed in the series of diagrammatic drawings O to X. This preliminary study may be made with string in case horsehair is not available. Two or more colors are desirable to give contrast to the different elements in the structure.

Border or Selvage Construction
Parallel Stripe Pattern

Refer to diagram J which shows the structural detail for a simple border pattern. Three strands, one black and two white, are indicated in the sketch. The upper and lower rows of loops or hitches are indicated in white and the center row is indicated in black. The numerals 1 to 5 represent the two cord foundations about which each strand is hitched. It must be remembered that the foundation cord is wrapped on the wooden mandrel (see Sketch A), one turn at a time.

The free ends of the strands are held in the left hand which also grasps the mandrel as indicated in Sketch E. Hitch each strand as follows:

1. Take the lower strand and make a **front hitch** around foundation cord No. 1, Sketch J.

2. Take the center strand and make a **front hitch** around foundation cord No. 1, Sketch J.

3. Take the upper strand and make a **front hitch** around the foundation cord No. 1, Sketch J.

4. Rotate the mandrel one turn to bring foundation cord No. 2 into position, which is on the right of cord No. 1.

5. Again make half hitches around this foundation cord with each strand in turn beginning with the lowest, this time using the **back hitch,** see Sketch H and I.

6. Rotate the mandrel one more turn to bring the foundation cord No. 3 into position for hitching.

7. Again make half hitches around this foundation cord with each strand in turn beginning with the lowest, using the front hitch, see Sketch F and G.

Repeat.

Diagonal Pattern

Refer to diagram K which shows the structural detail of the diagonal border pattern.

Four strands, one black and three white are indicated in the sketch. The upper and lower rows of half hitches are alternate front and back hitches formed as described above. The two center strands, one each white and black, which form the diagonal portion of the design are both made with front hitches as follows:

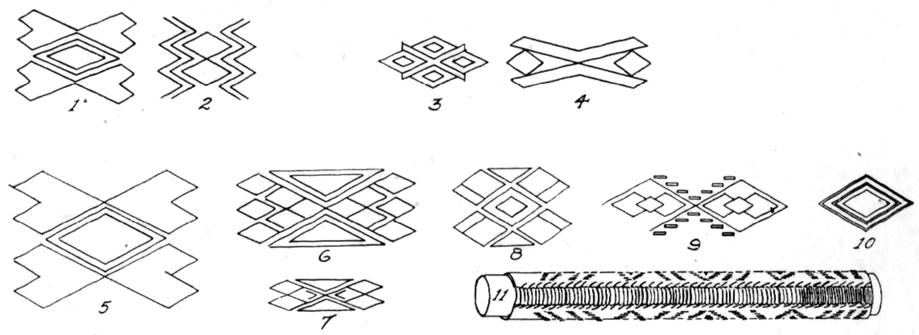
1. Front hitch the white strand around the foundation No. 1.

2. Press the black strand into the space between the free end and the loop of the white strand on top of Cord No. 1 and front hitch it over Cord No. 2.

3. Carry the free end of the white strand emerging from below the black strand, over Cords No. 1 and 2, see Sketch K, and front hitch it around Cord No. 3. Note the free end of the black strand is emerging between Cord No. 1 and No. 2, and below the white strand.

4. Carry the free end of the black strand, over Cords No. 2 and No. 3, and front hitch it around Cord No. 4. Note the free end of the white strand is emerging between Cords Nos. 2 and 3, and below the black strand.

Repeat.



Design Building

Experience in making border designs which require the use of both principles of half hitching should make clear the procedure in the development and construction of designs.

The design outlines shown in Sketches 1 to 10 have been selected from several pieces of hair work which may be considered representative exhibits of this type of craftwork. Two elements only are employed in the construction of any of these outlines, **the straight line** and **the diagonal line.**

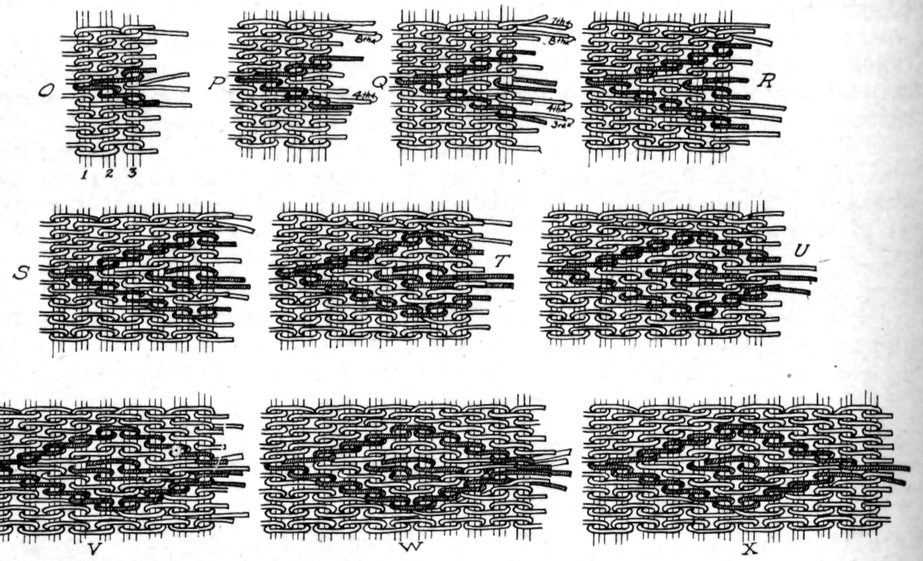
This restricts the choice of patterns to those of diamond or triangular shaped areas.

Straight line design elements are produced as described above for making a plain border. The line made by half hitching a strand of horsehair around foundation cords, **alternately** using the **front** and **back hitches** is straight, paralleling the **axis** of the mandrel. The width of this line is twice the thickness or diameter of the horsehair strand.

Diagonal line design elements are produced by half hitching a strand of horsehair, repeatedly using the same kind of hitch for the desired length of line. **Front hitches** used consecutively produce a diagonal line which rotates toward the worker, and when continued for the length of the mandrel becomes a spiral, rotating counter clockwise. Similarly, **back hitches** used consecutively produce a diagonal line which rotates back or away from the worker, and when continued for the length of the mandrel becomes a spiral rotating clockwise.

The use of the diagonal line with appropriate changes in direction, and contrasting colors applied to enclosed areas constitute the technic of design making.

The series of diagrams, O to X, portray the technic used in building a diamond shaped design element. The vertical parallel lines represent the foundation cord which are wound on the mandrel as the half hitch work progresses. The horizontal lines represent the strands of horsehair and the hitching procedure is indicated for each strand at each foundation cord. The symbolism shown in Sketches G and I, for indicating the technic of front and back hitching has been used in these diagrams. The interpretation of the specifications indicated in diagram O follows:



Nine strands of horse hair are shown in diagram O, eight of which are white and one black. Four of the white strands appear below the black strand and four above. Those below the black strand on **front hitched** around the foundation cord No. 1. Those above the black strand are **back hitched** around the foundation cord No. 2. The black strand is not hitched around the foundation cord, it is merely slipped over it and both ends extend to the right. After the next foundation cord is wrapped on the mandrel, the procedure indicated by the diagram is the following:

Starting at the bottom of the diagram **back hitch** three of the white

strands around foundation cord No. 2. The fourth white strand is not half hitched around the foundation cord, instead it is carried over the foundation cord and the free end is covered by the foundation cord No. 3 when it is wrapped on the mandrel. It is necessary from time to time to **drop out** a strand which forms the background area in this manner, to accommodate the strand forming the design. Referring again to diagram O the specification indicates that the black strand passing over the foundation cord No. 1 is to be front hitched around foundation cord No. 2. Also the other end of this black strand is carried over the foundation cord No. 2.

Again the diagram O indicates that the next three white strands are back hitched around foundation cord No. 2. The fourth and last white strand is not hitched around but merely carried over the foundation cord No. 2 and is also **dropped out** by being carried below the foundation cord when wrapped on the mandrel. It will be noticed that the fourth and eighth white strands have been carried under the foundation cord No. 3. This technic is known as **dropping out** a strand. Also note that these **dropped out** strands have been replaced. At the middle point below the two black strands the replacement takes place. The white strand is not hitched around the foundation cord No. 3. It is merely slipped over it as indicated in the diagram, both ends extend to the right.

The hitching specifications for foundation cord No. 3 as given in the diagram O follows:

The lower white strands—first, second, and third—are to be front hitched around foundation cord No. 3. The fourth white strand is not hitched but is carried under foundation cord No. 3. This strand is being **dropped out** to make room for the lower black strand which is to be front hitched around the foundation cord No. 3. The upper black strand is to be back hitched around foundation cord No. 3. Also the rest of the white strands are to be back hitched around foundation cord No. 3.

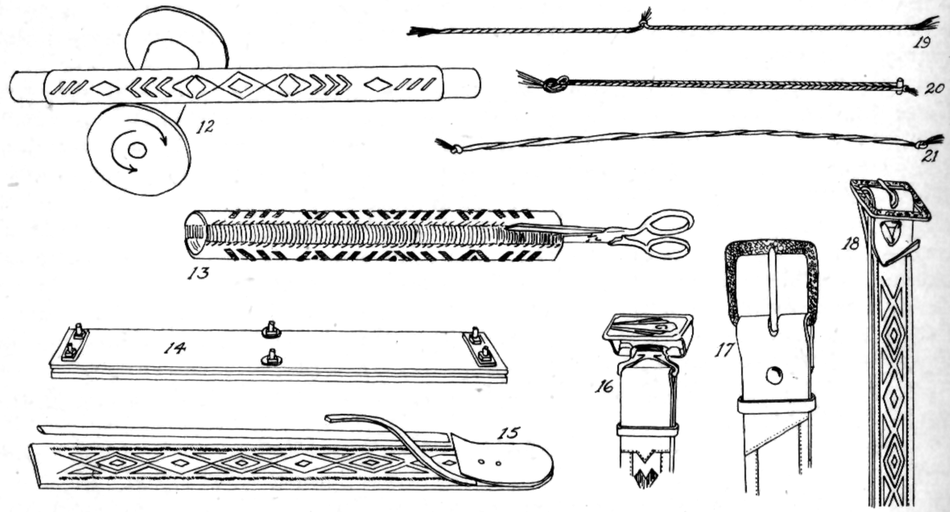
It should be noted that this procedure has started the diamond pattern which is developed step by step in the succeeding diagrams. The diamond pattern reaches the maximum width or spread in diagram R. In order to develop this pattern it has been necessary to drop out two more white strands. This process is indicated in diagram Q and the four strands thus dropped out, or carried below the foundation cords are the third, fourth, seventh and eighth. Also in diagram Q the space left vacant by dropping out a pair of white strands is occupied by the addition of a black strand in the center of the black diamond. These strands which have been dropped by carrying them under the foundation cords are **picked up** as needed to fill the spaces created by the black strands as they converge to the point of the diamond design. The points where these white strands emerge or **are picked up** will become evident from an inspection of the work. This series of diagrams show the hitching specification at each point in the development of a typical design used in hair work.

Remove Hairwork from Mandrel

A wooden mandrel shown in Sketch 11, page 433, has been covered with a piece of half hitched hairwork. This must be made soft and flexible with water. Either immerse the mandrel in water or pour water over it. Roll the mandrel across a wood spool, see Sketch 12, page 436, moving it back and forth, under pressure. Gradually rotate the mandrel to insure all parts of the hairwork coming in contact with the spool which smoothes out irregularities and compresses the hair loops together.

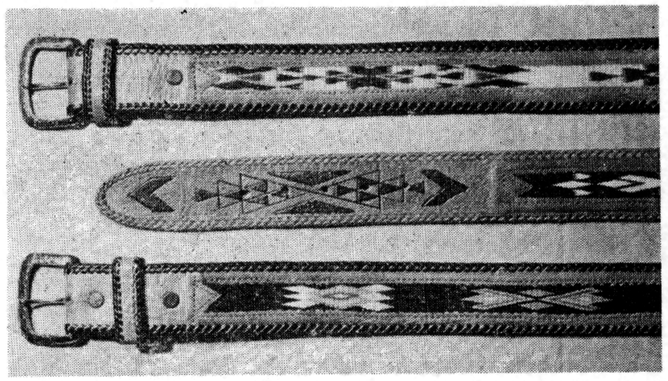
Dry the hairwork, and remove it from the mandrel, which is slightly tapered to facilitate this operation. Sketch 13 shows a tube of horsehair work, consisting of two half hitched sections separated by a space of uncovered foundation cords. Cut these cords to separate the two hair strips.

The strips of horsehair are again soaked in water until soft and pliable. Then place them between two hard wood boards and apply pressure with clamps or bolts. Sketch 14 indicates a press made of wood held together by bolts and nuts. Tighten the clamps while the hair is drying to maintain pressure on the strip for the hair shrinks as it dries. Remove the dry strip and trim off the loose hair on the back, also the ends of the foundation cords to a uniform length of about 3/16".



Mounting Horsehair Strips

The mounting of pressed horsehair strips is almost entirely a leather working procedure. The strip is attached to a piece of leather with flexible cement. The flesh side of the leather (usually Mission steerhide, 2½ to 3 ounce weight) is coated with cement which is permitted to dry partially. A second coat of cement is applied and the hair strip pressed into the cement in its proper position. Sketch 15 shows a belt in the process of construction. The hair strip is shown attached to the lower piece of leather. Two narrow pieces of leather wide enough to cover the foundation cord fringe which extends some 3/16" beyond the hair strip and overhang the edge of bottom piece, are cemented in place, Sketch 15.



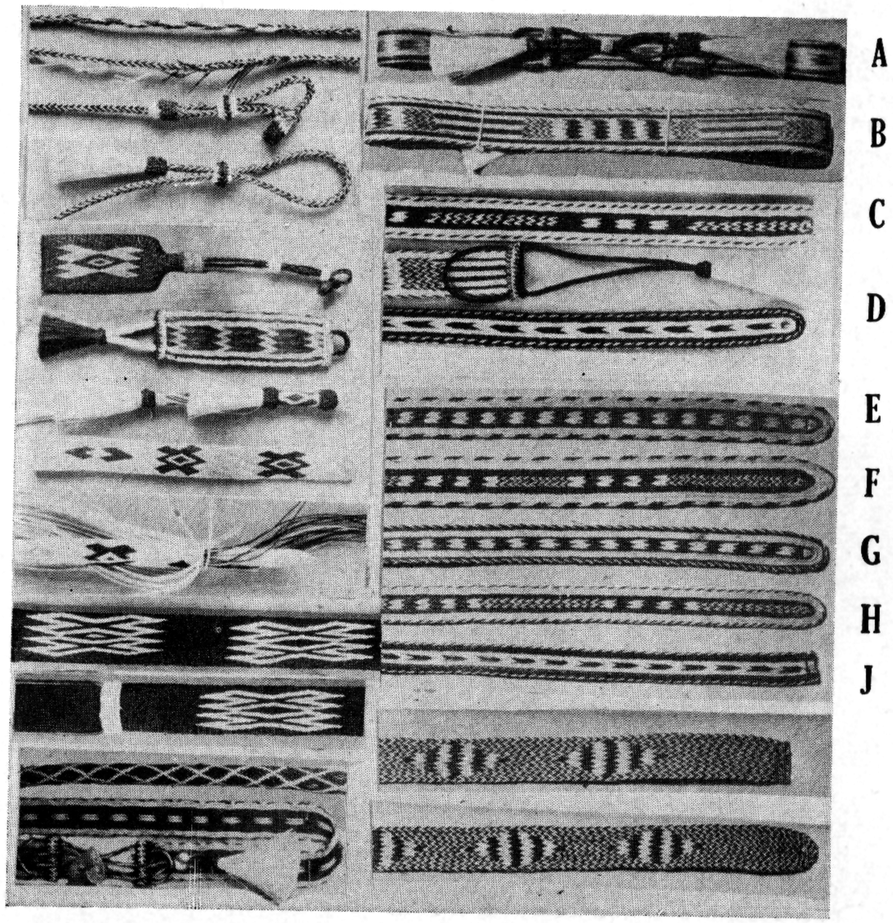
The edges of these cover strips should be skived thin where they overlap the foundation cord fringe to make a neat joint along the side of the hair strip. Cement top cover pieces to each end of the belt with the ends skived or thinned down to fit neatly over the end of the hair strip.

Sew the cemented pieces to the base on a sewing machine. This work can be done on the ordinary household machine without injury to the machine when Mission Steerhide is used. This leather is soft, pliable, durable, and does not mar readily.

The edge of the belt should be trimmed, creased, edge stained, and sewed, when a plain edge is desired. In case the edge is to be finished by edge lacing, it will be necessary to trim the belt ⅛" narrower than the buckle width. See page 56 for several types of suitable edge lacing. Several types of buckles and end finishes are suggested by Sketches 16, 17 and 18. The finished belt should be given a light application of leather dressing and the edge lacing a light coating of a burnishing wax, or lacquer.

Preparation of Horsehair for Half Hitch Work

Horsehair is obtainable in several lengths—24" to 28"—and may be purchased by the pound. Twisted strands of horsehair, containing 8 to 10 hairs each, are used for half hitch work. The hair in each strand should be twisted just enough to hold them loosely together. One procedure in preparing strands is to take two bundles of hair, 4 or 5 single lengths per bundle, and tie the ends of each bundle together as indicated by Sketch 19. The single strand with the knot in the middle is rolled or twisted together. It is then folded and placed over a support as indicated in Sketch 20. Both strands are kept under tension until a knot is tied in the end. The tension is then removed and the two strand twist loosely together is indicated in Sketch 21.



Primitive Indian Handicraft

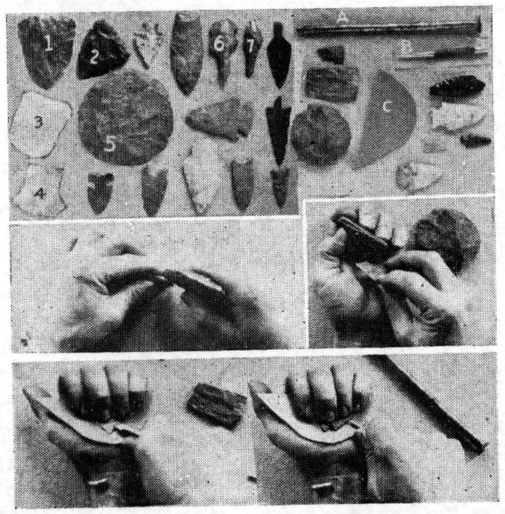
American youth today is struggling with terrific conflicts due to the rapidly changing economic and social structure. Under our highly specialized civilization, living is complex and artificial. We must help him emerge from adolescent instability, with a receptive mind, capacity for achievement and sensitive to spiritual and cultural values. Many and subtle are the values found in the camp and club program based upon the activities of the native American Indian. Unlimited opportunities are afforded for normal wholesome expression of the creative urge in youth. He recognizes the skill, ingenuity and tireless effort back of the Indian's work when he attempts to follow Indian technique and use native materials, and appreciates the fact that the Indian possesses the true spirit of the artist craftsman with whom time and effort count little and the achievement of purpose means so much.

Stone Flaking

The Art of Toolmaking from stone was highly developed among the American Indians. Many collections of Stone Tools contain knives similar to those shown in the photographs, Nos. 1 and 2, scrapers, Nos. 3 and 4 Flaking Hammer No. 5, Drills Nos. 6 and 7. Arrow and spear heads are also shown.

The use of the flaking hammer is indicated in the photograph. A spawl or large flake of stone is chipped off by striking the piece of stone a blow with the edge of the hammer. A little experimenting with a good flaking stone such as obsidian or flint, jasper and others will determine the proper striking angle to yield a large thin flake suitable for toolmaking. The photograph shows a flake large enough to make an arrow head, removed from a piece of petrified wood by a blow of the flaking hammer.

The flaking tool of the Indian, we are told, was made of bone and antler prongs, ground to the proper size and shape by rubbing the tips on rough stone. Excellent arrowheads, however, may be made with an 80 penny nail (A). The only other piece of equipment needed is a protective covering for the palm of the hand. The piece of leather C is shown in use in the lower photograph. The large spike, (80 penny nail) is used to break the edges of the spawl, and give it the general shape of the tool (knife, arrowhead, etc.) under construction. The pressure of the spike is first downward and at right angles to the edge of the spawl. This yields the approximate shape. Then to bevel and sharpen the edge, the spike is held almost perpendicular to the edge and pressure directed downward. The fine point of a bone flaking tool is suitable for finishing the arrow barb and the extreme tip shape, where small flakes are to be removed.



Arrowhead Making

The Indian designed his Arrowhead according to the purpose for which he wished to use it. The hunter of big game required an arrow that would cut deeply through the tissues and cause free bleeding. At times an arrowhead was designed to stun rather than kill his game. An interesting Classification of arrowheads is given in the Report of the American Bureau of Ethnology, Smithsonian, Bulletin No. 30, 1907, Handbook of the Indian.

The arrowhead shown in Sketch A, Fig. 18, has been detailed to conform with the government classification as follows: A, point; B, edges; C, face; D, bevel; E, blade; F, tang; G, stem; H, base; I, notch; K, neck; M, barb or shoulder. Sketches B and C show how the beveled edge of an arrow appears when flaked first from one side then the other.

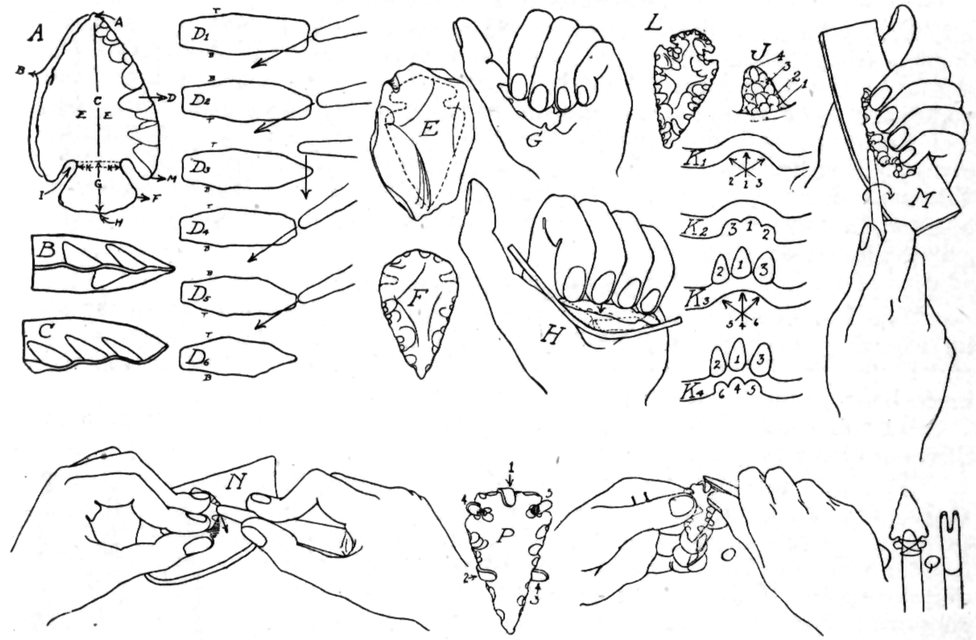


Fig. 18

Arrowhead shaping and edge beveling is accomplished by means of pressure applied with a bone flaking tool. The piece of flaking stone or spawl, see Sketch E, Fig. 18, will probably yield an arrowhead of the shape indicated by the dotted outline. The cross sections, Sketches D1 to D6, indicate the method of applying the pressure to the spawl with the bone. The spawl is held firmly as shown in Sketch G, with the top of the bone pressed downward and against the under side of the stone, Sketch D. The broken chip is caught by the leather palm protector which takes up the impact of the tool. The spawl is turned over and another flake removed, Sketch D2, then the thinned and beveled edge is broken off, Sketch D3. The process of alternately chipping the top and bottom corners, then breaking the edge is continued until the spawl is reduced to the desired shape. Sketch F. The spawl must be kept on the base of the thumb as in Sketch G, or on the outer side of the hand, so that it has a level support. **Do not** let it shift into position H, with the support only at each end, as pressure at the unsupported point indicated by arrow may break the spawl instead of chipping a flake as desired.

Notching the Arrowhead

The Notch I between the Barb M, and the Tang F, Sketch A, is chipped out by pressure as above described. Four successive flaking operations were required to produce the notch shown in Sketch J. In Sketch K1 three pressure points in starting the notch are indicated. Removal of the chips at these points results in the started notch, K2.

Sketch K3 shows the reversed side of the spawl from which the flakes, 1-2-3 have been removed, also the points 4-5-6, to which pressure is applied as before. Sketch K4 indicates the appearance of the notch after these chips have been removed. In Sketch J the points 1-2-3-4 indicate the four steps in the process of removing the four sets of six flakes, three from each side of the spawl. This procedure is continued until the desired depth of notch is obtained. L is the finished head, ready to mount.

Finishing the Arrowhead

The edges of the shaped arrowhead, Sketch J, will be somewhat uneven where flakes of uneven size have been removed. Additional flakes should be removed from the thicker portions and blunt edges, and any edges which are too thin and sharp may be trimmed off by placing the hand flaking tool firmly against the edge of the arrowhead, Sketch M, and rotating it inward. Another way of finishing the arrowhead is indicated in Sketch N. The arrowhead is pressed firmly against a piece of soft leather which rests against the table top. The flaking tool is pressed against the edge to produce a beveling or shaping cut.

Mounting the Arrowhead

The Indian mounting consisted of attaching the arrowhead to the shaft by inserting the base in a notch cut in the end of the shaft, Sketch Q. The end of the shaft was then wrapped with wet sinew, which gripped the arrowhead securely when dry.

The method of mounting an arrowhead for a scarf pin is described in Silversmithing Section.

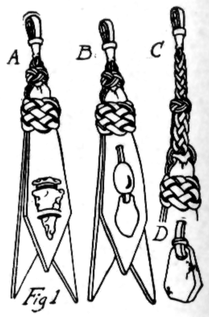


Fig 1

We are indebted to Prof. J. M. Drew, of the University of Minnesota, for the arrowhead fob pendant, mounted as shown in Fig. 1, Sketch A. Sketches B and C show a method of mounting shell and turquoise. Three styles of attachment straps are shown in insert (on page 441). Sketches F, J, and K. F is the split strap type. The other two shown in Sketches J and K are made of plaited thongs, J being four plait flat, and K four plait round. See pages 106 and 108 for plaiting detail.

The split strap type attachment, Sketch F, Fig. 19, is made with a strap ¼″ to 3″ wide and 16″ long. About 4 inches of one end is passed through the ring of a fitting, and slit just below the ring as indicated in Sketch A. The long end of the strap is passed through the slit as indicated by the arrow. This is pulled up snug to grip the ring of the fitting, and a slit cut in it the width of the strap below the first loop. The short end is then passed back through this slit, and in turn slit to form the second loop in the long end. This process is repeated until about three inches of the strap is made. This will leave the short end about an inch long and the other will be of sufficient length to make the knot as in Sketches P to T.

Both ends of the strap are passed through a hole punched in the two pendant straps just back of the fold, out through a second hole, and back through a third. The long end is then passed through a hole in the front of the pendant straps, E, and pulled up tight, concealing the short end in the fold as shown in Sketch C.

The folded portion of the fob is trimmed down to reduce the bulkiness as shown in Sketch E, before the three bight knot is tied to conceal the end

Making the Three Bight Knot

The construction detail of the three bight knot is given on page 113 The detail of the knot as used on the pendant fob, E, Fig. 19, is indicated in the Sketches P to T. The appearance of both sides of the knot as it is formed are shown for comparison with the actual work as it progresses step by step. The back or under side of the knot is shown in Sketches Qb, Rb, and Sb.

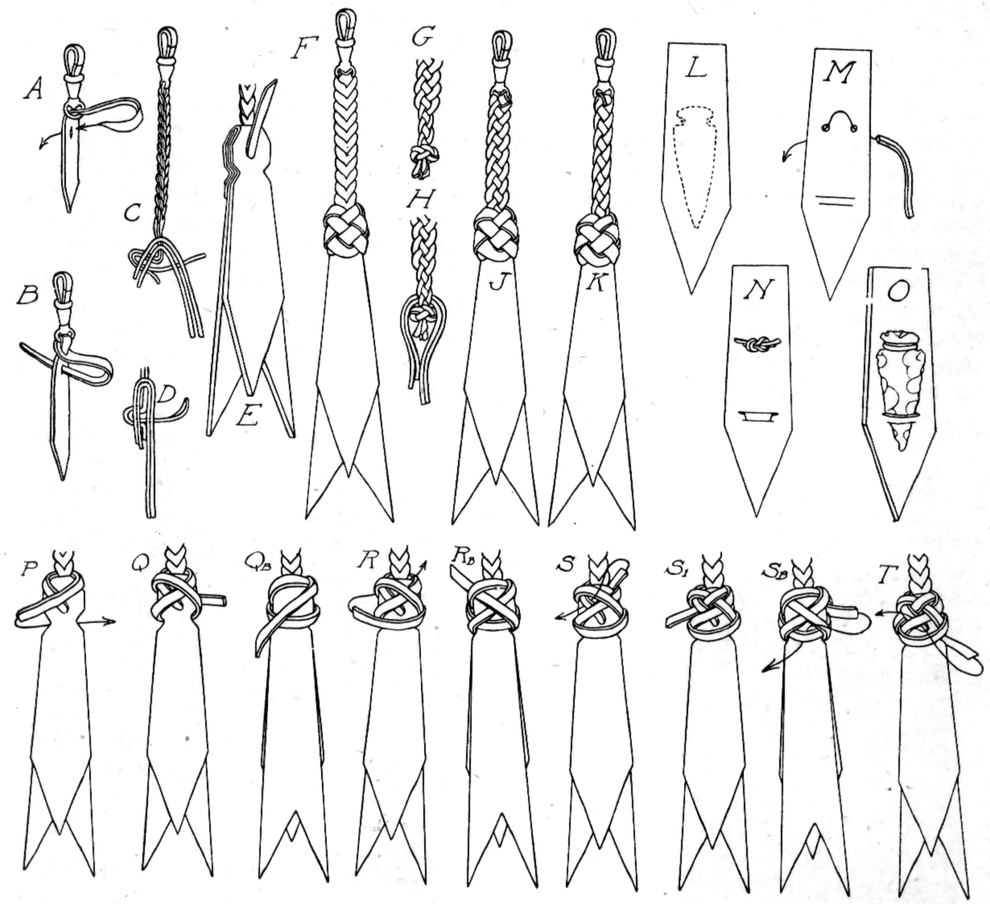


Fig. 19

Mounting the Arrowhead on the Fob

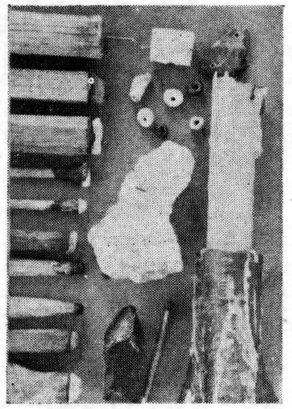
In Sketch L the position of the arrowhead is indicated by the dotted outline. The location of the arrowhead notches are marked, also the points where the slits are to be cut. Holes are punched as indicated in Sketch M to receive the thong which grips the arrowhead at the neck. Two slits are cut at the points indicated through which the point of the arrowhead is passed. Sketches N and O show the appearance of the fob, front and back after the arrowhead has been slipped through the slits, and fastened securely by a thong passed around the neck of the arrowhead, through the fob straps and tied in a square knot on the under side as in Sketch N.

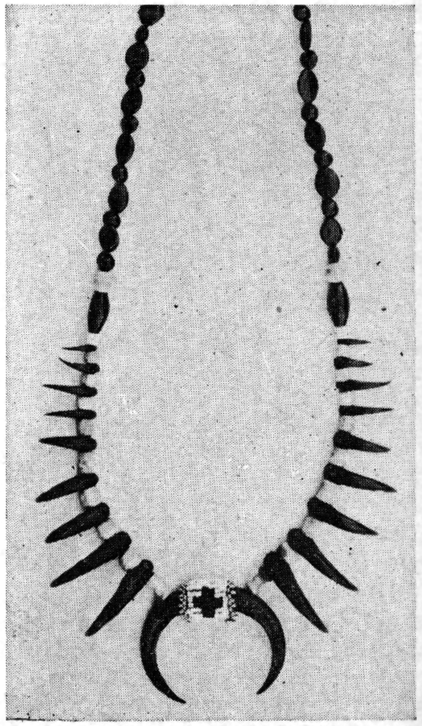
Bead Making

Drilled pieces of turquoise to be made up in a necklace are strung on a strong cord or thong and ground to the desired shape by drawing the strand back and forth across the abrasive stone. Deep grooves have been worn in the rock ledges of the Indian country where turquoises have been ground and polished for generations. The pressure on the strand may increase or decrease as it is rotated and pulled back and forth in the groove. This variation in pressure yields a graduated diameter in the finished strand.

Similar strands may be made from shells, gypsum, soap and pipe stone, jet and other soft stones in this same manner. The drilled pieces of stone may be more easily handled by slipping on a long knitting needle, or piece of wire, and shaped by rubbing against a stone, abrasive paper or cloth.

Bone, horn, shell, teeth, claws, talons, and the softer stones were a few of the materials used by the primitive American Indian for his adornment. Headbands, ear pendants, neckbands, necklaces, armbands, belts and other articles were frequently made of beads and small discs cut from these materials and held together by a strand of sinew or a buckskin thong. Many of the strands of shell discs or beads were quite uniform in diameter, and when of varying sizes were uniformly graduated. No doubt the native tools and methods employed by the early craftsman were similar to those used by the Pueblo Indians of the present day. The methods used by the Indian in shaping and polishing turquoise and other stones for silver mounting, also beads for necklace strands are primitive and readily adapted to the Handicraft Program.





The Necklace shown in the accompanying photograph is made up of claws, talons, shells, bone, and beads.

The Pump Drill

The primitive Indian pump drills were ingenious creations employing mechanical principles of a high order. The present day Indian uses drill points made of steel (pieces of old files, darning needles and commercial drill bits) instead of pointed pieces of flaked stone (used by his ancestors). See drills No. 6 and 7 shown in photograph, page 438. Such drills were attached to the end of the drill shaft with sinew and served to perforate the softer stones employed in bead making.

The pump drill shown in Fig. 12 consists of the following parts: A drill shaft counter weighted near the lower end by a disc of wood; a cross stick which fits loosely around the drill shaft and is attached to the shaft by a leather thong. A thong passes through a slot in the top of the drill shaft and is attached to each end of the cross stick.

The pump drill is operated by twisting the thong tightly about the drill shaft. This raises the cross stick toward the top of the shaft. By exerting a downward pressure on the cross stick the drill shaft will revolve and the leather thong unwind. The weighted drill shaft will continue to revolve for a moment after the pressure on the cross stick is removed. This rotation is sufficient to rewind the leather thong about the drill shaft while the cross stick is lifted to its upper position. Downward pressure again exerted on the cross stick will revolve the drill. The direction of rotation of the drill changes with each down stroke. A little practice will develop the necessary skill to use this primitive type of drill which cuts with surprising rapidity.

Drilling Shells and Turquoise

Hold the piece of turquoise to be drilled firmly upon a board. Spin the drill handle, Sketch A, to wind up the supporting thong to the position shown in Sketch B. Place the drill point upon the turquoise and press downward on the handle, as indicated by the arrow, Sketch B, till it is in position C. Raise quickly to the position D and continue the up and down pressure. The momentum of the weighted shaft is sufficient to keep it revolving and the supporting thong winds and unwinds as indicated, while the drill point is driven through the turquoise.

This type of drill finds convenient use in all materials where a pierced decoration is employed.

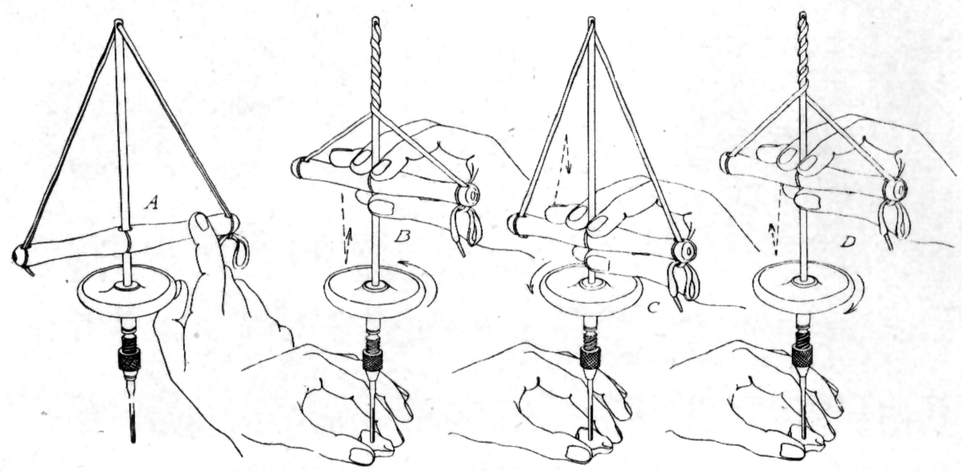


Fig. 12

PRIMITIVE CRAFTS

BONE AND HORN HANDICRAFT

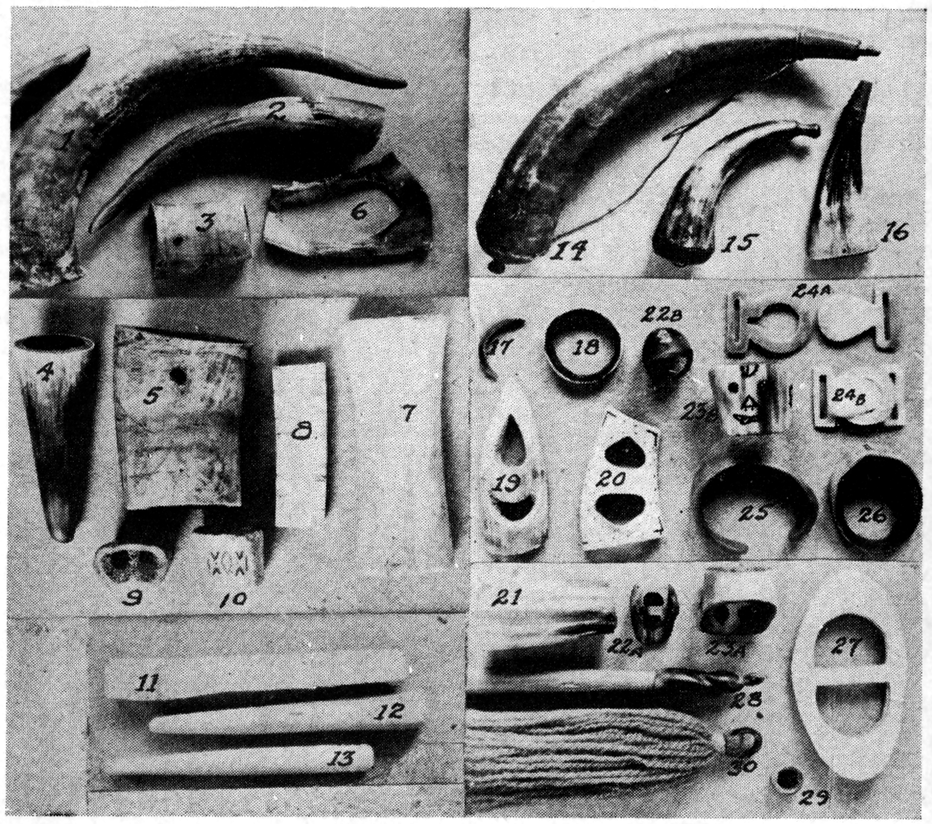
Spoons and various utensils of horn were used in medieval times, and one use at that time is still practiced to a small extent in the making of lanterns glazed with thin transparent sheets of horn. Shakespeare swore "by the great horn spoon" and "the Hornbook" which he mentions, was a name applied to a sheet containing the letters of the alphabet, mounted on wood and protected with a sheet of transparent horn, or merely pasted on a piece of horn. This was carried around by children, suspended from the girdle and used as a primer.

The earliest known musical instrument was made from a horn and this name is still used for all so-called wind instruments although no longer made of this material.

Horns were extensively used in this country in Colonial times, and during the Civil War. The Cap and Powder Horn were necessities in the days of the muzzle loading musket. The sportsman controlled his pack of hounds, and the hunter lured his game within shooting range by the sound of his Hunting Horn. These articles were introduced into this country by the English Colonists, and had been in use in Europe from the earliest medieval times through the middle ages.

Horn as a Handicraft Material

Horn as a Handicraft material is excellent. It is easily worked and few tools are necessary. It may be cut with knife, file and drill, and takes a high



polish when scraped, sanded and oiled. Sections of flattened horn may be made into such articles as belt buckles and slides, windows for rustic lighting fixtures and other articles.

BONE AND HORN

In the photograph, No. 1 is a horn in the natural state. No. 2 shows appearance after polishing and 3, 4, 5 and 6, horn sections, 7, 8 and 9 are bone sections and 10 a neckerchief slide made from section 9.

Nos. 12 and 13 are arrow flaking tools as are shown in Fig. 18, Page 444. These are sawed from a bone and filed to shape. 14, 15 and 16 are genuine powder horns used in New England before and during the revolution. Nos. 17 and 18 are sections of horn from which claws and other Indian necklace ornaments may be filed. Nos. 19, 29, 22B, 23B are neckerchief slides, 24A and 27 Belt Buckles and 28 an Archery Bow Tip. 30 is an Archer's Tassel, made of yarn looped through a horn ring and tied with a turks head knot.

Projects Made From the Entire Horn

The historic powder horn was essential to users of muzzle loading fire arms. It kept the powder dry, furnished a container of sufficient capacity to insure an adequate supply for the hunt, and made possible the loading of the gun by means of the funnel shaped tip, from which the powder was poured directly into the muzzle.

The powder horn shown in Sketch F, page 448, indicates the typical construction. A wooden plug is shaped to fit, and wedged tightly into the base of the horn. This is held in place by small tacks or nails driven through the horn into the wood. A hole is drilled through the plug, and the horn filled with powder by pouring through this hole. The opening is kept corked with a tight fitting wooden peg.

The tip of the horn is tapered to a diameter small enough to enter the muzzle of the gun. A hole is bored through the solid tip into the cavity, and when not in use as a funnel for charging the gun, is plugged with another wooden peg of the same type as that used in the base.

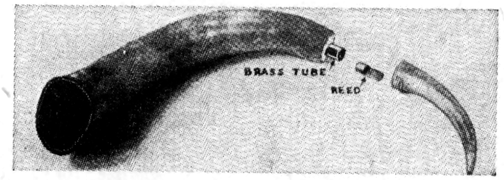
The horn is carried by a strap or thong attached as indicated, Sketch F, Fig. 5, page 448.

Such a powder horn makes an excellent container for the tinder used in fire by friction sets. For this purpose the base should be removable.

A Horn Bugle

Scout Executive A. E. Roberts, Director of Camp Friedlander, Cincinnati, Ohio, has developed a bugle suggestive of the Robin Hood Hunting horn. It cannot, however, be used to "blow a mighty blast," but emits a rich mellow tone when made according to Mr. Roberts specifications which were described in the October number of Scouting, 1928, and which he has kindly permitted us to quote as follow:

"A cowhorn from which the bone has been removed is used. With a flexible wire or twig, find where the hollow of the horn ends, then about a half inch from this toward the point of the horn, saw through. A hack saw does a neat job.



"On many of the horns when sawed through, a white spot may be seen indicating the center of the horn. With a three-eighths inch drill, bore a hole clear through into the large hollow portion of the horn, and with the same drill bore back toward the point of the horn a distance of about one inch. This hole provides for a piece of hollow brass tubing which will not only form a strong union when assembled, but provides a receptacle for a brass reed which makes it easy for anyone to blow. A quarter of an inch hole may be continued back and out through the point of the tip for the passage

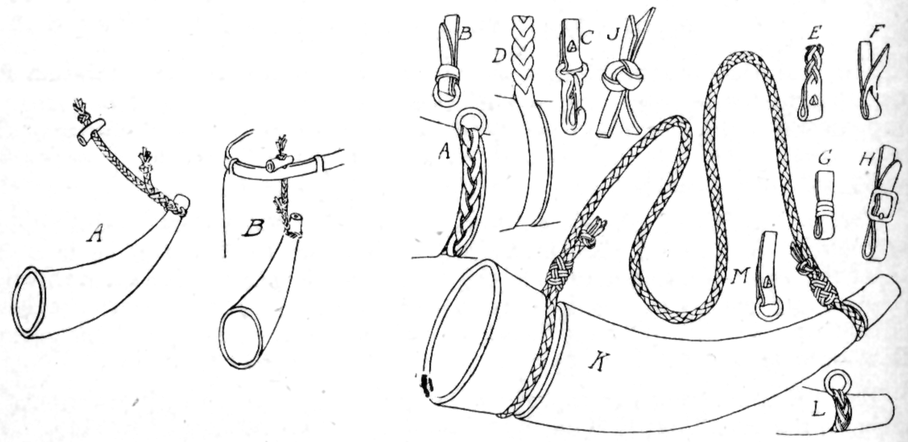


Fig. 1

of the air from the mouth to the reed. The reed may be securely fastened inside of the brass tubing by turning down the tubing slightly and applying a cement, then inserting the reed. Let dry and then blow to see that the reed works properly before assembling the horn. Sometimes a little cement getting on the vibrating part of the reed will prevent it from functioning properly, and it is best to be sure as to this before assembling. The next step is to apply cement freely to brass tubing and the inside of the horn and then assemble. If care is taken to get the horn parts together as they were before cutting, a perfect joint may be made. Polishing will make a finished job."

A suitable carrying strap for tinder horn or bugle may be made from lightweight strap or plaited thongs as indicated in the sketches A to M, Fig. 1. The several methods of making attachments are given in detail on pages 81-83. Sketches A to L show rings attached with Turks-head knots which fit snugly into grooves filled in the horn. The Cinch fastening, Sketch B, is described on page 81. Sketches E and M are applications of the three hole fastening described on page 81. The split Strap Braiding is described on page 84 and the Turkshead knot, Sketch K, is detailed on page 83.

A four plait round strand, finished with Turks head knots and secured with sliding knots is shown in Sketch K. Instructicns for the plaiting and knots may be found on pages 106-111.

The Decoration of Bone and Horn

The decoration shown in Fig. 4, Sketches A, B, C, D, E, F, M, O, Q, S, T, V, are made with the engraving tools as shown in Sketches G and H. The graving tool G cuts a V shaped groove shown in cross section G1. Tool H cuts a square bottom groove shown in cross section H1.

Fig. 4

The grooves are filled with monogram filler, a wax like preparation which is applied as shown in Sketch G2, by rubbing the stick back and forth across the cut or grooved design. Any excess filler adhering to the surface around the grooves may be removed with a cloth, see Sketch G3. Sketches G4 and G5 show the design and a cross section thus filled.

The method of cutting a square corner, Sketch H4, is indicated in Sketches H2 and H3. The direction in which the graving tool moves is away from the corner. An effective border line cut, Sketch J, is made with

tool H by moving it so that it cuts first on one corner then on the other, as indicated by Sketches J1 and J2. In reality the cuts are as indicated in Sketch J3. This type of cut is called a riggled line by engravers, and is attractive when defined by the addition of monogram filler.

The neckerchief slide, Sketch A shows the application of monogram filler of different colors. The nose and mouth are outlined with brown, the nostrils and tongue are red and the lock of hair is gold, the eyes are diamond faced jeweled ornaments set into the slide and held with sealing wax. Sketches R, R1 and Q. The bone or horn is drilled from the back. Often it is desirable to cut away part of the back, as sketch Q1 and Q2 to permit the drill to operate freely.

Belt Buckle

Fig. 5. Sketch A, B, indicates the procedure in making up a belt buckle. The buckle is designed and the outline drawn to size and shape, is glued to a piece of flattened cowhorn. When it is dry, holes are bored in each enclosed area as shown in Sketch A. The saw blade is passed through the drill hole and the section to be removed cut with the saw as indicated in Sketch A.

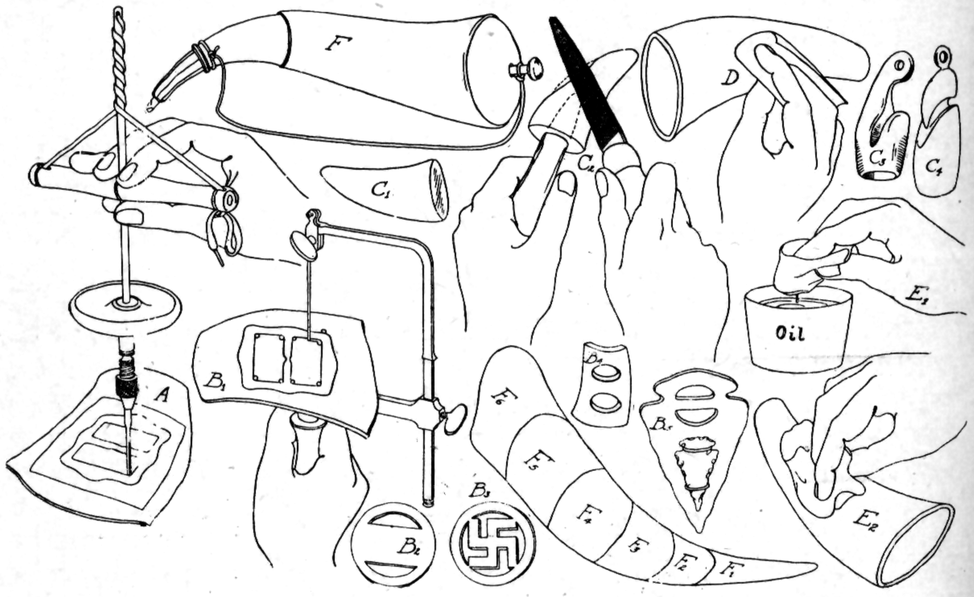


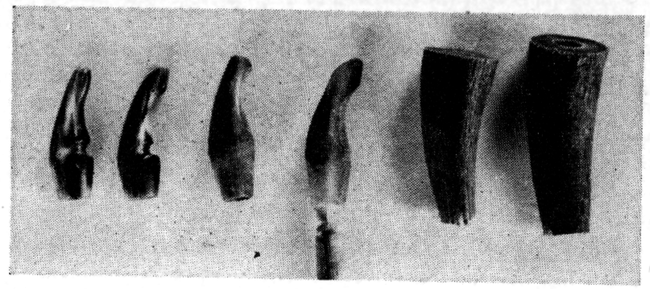
Fig. 5

The Sketches B2 and B3 show neckerchief slide designs which may be cut from flattened pieces of cowhorn. Sketches B4 and B5 are made of horn sections hollowed out, carved and polished. Sketches F1 to F6 indicate the division of the horn into sections for the projects shown in Fig. 4, Sketches K to V.

The Archer's Bow Tip

The Archer's cowhorn bow tip was highly prized in Robin Hood's day, and may still be made by Archery enthusiasts in the same way.

Bow Tips are made from the solid tip ends of the cowhorn, similar to the piece shown in Sketch C1. C2 shows the top drilled, and a stick of wood, approximately the size of the end of the bow on which the tip is to be mounted, inserted in the hole. This serves as a handle while the tip is filed and polished. The shapes C3 and C4 are readily cut to the desired



shape and the grooves filed with a half round and rat tail file, as in Sketch C2. After the shaping process is completed, the file cuts and scratches may be removed by rubbing with a piece of 3/0 or a finer grade of abrasive paper or cloth, see Sketch D. The polishing is done with a cloth which has been dipped in boiled linseed oil, Sketch E1, sprinkled lightly with powdered pumice stone, and rubbed well over the surface of the horn, Sketch E2. For the final polish, an oiled cloth without the pumice is used.

Sketches P to P2, Fig. 4, page 447, show the construction of an Archer's Tassel made of yarn and a horn ring and held with a Gaucho knot.

KUKUI NUT NECKERCHIEF SLIDE

Kukui Nuts grow in the Hawaiian Islands, and are used by the natives for food, fuel, illumination, also as a time measuring device. The nut meat is nutritious and of excellent flavor. When burned the hard shells produce a flame of high temperature and the oil from the nut meat gives illumination of mellow quality. The time required for burning a nut is about fifteen minutes and four average size nuts will burn in approximately one hour. This bit of romance was supplied by the author's friend, James C. Wilder, along with the Neckerchief Slide made from a Kukui Nut, shown above.

The shell of a Kukui nut is rough, thick and quite hard. It may be cut with the tools used in working bone and horn. Sketches C and D show the method of making a slide from a rough Kukui. The method of polishing, engraving and decorating with monogram filler is the same as described on page 447.

The increasing demand of the traveling public for silver ornaments has stimulated industry among the Indians, also others who are making quantities of silverware for tourist trade. Consequently shops are to be found at some of the Pueblos, containing modern jewelry manufacturing equipment, and where native skill and ability has access to these improved facilities, the art of silversmithing has been advanced. Unfortunately the promiscuous buying by many tourists, sometimes knowingly, of factory made imitations, constructed of baser metal, and given a high polish, has been damaging, temporarily at least, to the demand for the genuine Indian article.

In the dwelling places of the Indian craftsmen, removed from the beaten trail of tourist travel, are to be found silversmiths producing articles for his own use. These he treasures and will part with only when dire necessity compels using them for a pawn, which he frequently is unable to redeem.

In the hogan of a Navajo silversmith visited by the writer in the fall of 1927, the silverworking equipment, with but few exceptions (and those which made the equipment less complete) could be accurately described in the words of Washington Matthews, who, 51 years ago in his article on Navajo silversmiths, published in volume 2, Bureau of Ethnology Report (Smithsonian) says:

"Their tools and material are few and simple; and rude as the results of their labor may appear, it is surprising that they do so well with such imperfect appliances, which usually consist of the following articles. A forge, a bellows, an anvil, crucibles, molds, tongs, scissors, pliers, files, awls cold chisels, matrix and die for molding buttons, wooden stake, basin, charcoal, tools, and materials for polishing (sandpaper, emery paper, powdered sandstone, ashes, and solid stone), materials for whitening, a native mineral substance, almogen (hydrous sulphate of alumina) salt and water."

A genuine interest, thus awakened, will lead far into the field of research, that has made available thru Ethnological reports of the last half century, a vast amount of information. Many of these reports are classics in themselves, and well worth the effort to search out and read.

The Navajo silversmith's workshop is on the ground, and scattered about him are his tools, all within easy reach, spread out on pieces of skin or cloth, into which the tools may be rolled when not in use. Seated upon a sheep pelt or blanket, with his legs crossed, frequently removing his moccasins for greater comfort while crouched over his work at anvil or forge, he will labor steadily for long periods of time. At frequent intervals, upon the completion of some process or when an intermission can be had, he will recline upon his blanket, and relax for a brief period before proceeding with his work.

Suggested Projects for Camp Use

The kinds of work to be done might be grouped as follows: 1, Melting and casting of silver ingots. 2, Drawing the ingot into sheets. 3, Methods of shaping and decorating. 4, Cleaning, polishing, and mounting turquoise.

Melting and Casting Silver Ingots

The tools required are, almost any kind of a receptacle to hold the charcoal, from a wash basin to a wooden box filled with mud, and hollowed out to receive the charcoal. Bellows—hand type is common for raising the heat to the melting point of silver. Crucible—old Indian pottery—small commercial crucible, graphite or fire clay—must be smallest size, as the amount of silver melted for most projects will rarely exceed an ounce, and when molten will not be larger than the volume of a tablespoonful of liquid. A graphite crucible is readily cut down to the appropriate size with a saw or knife. It is desirable to have the crucible not more than an inch

deep. Mould—any piece of stone that may be cut by knife or chisel will be suitable for making moulds. Depressions of various sizes and shapes are made in the stone to receive the molten silver.

Melting and Casting Procedure

Kindle a small fire (wood) in the center of the forge, or box, mud lined, about 10" in diameter, and place pieces of charcoal on the fire. Blow gently with the hand bellows till the charcoal is ignited. Place the silver to be melted, usually Mexican coin, into the crucible, and place it in the center of the fire, with the charcoal heaped around and over it. Keep a steady draught of air from the bellows playing upon the forge, so that the heat of the crucible will be uniform. The melting process may be observed between the embers, and when the silver is ready to be poured, grease the stone mould with suet, beef or mutton tallow. The silver is poured into the oiled mould, and left to cool for a few minutes. The ingot will shrink while cooling and may be removed soon with a pair of pliers.

Drawing the Ingot Into Sheets

Place the ingot on the hot coals and re-heat to a dull red color. Grasp with a pair of pliers, and place it on the anvil, (the Indian uses the heads of large bolts driven into the ground, or a piece of railroad rail) and flatten it out to the desired shape by drawing or hammering as the metal cools. Work from the center out taking care not to hammer the edges thinner than the central portion. This may be prevented by striking the ingot occasionally on the edges to compact them. Hammering makes the silver hard and brittle so that it will be necessary to re-heat it frequently during the drawing process, to anneal or soften it, and to prevent cracking during the final shaping operation. Care must be taken not to overheat the thin edges of the silver during the annealing process, that is they must not be carried beyond a dull red color.

A little experience in drawing the ingot into the desired shape and thickness will guide the silversmith in producing moulds of the proper shape and depth to produce rings, bracelets and other articles with a minimum of hammering.

Methods of Shaping and Decorating Silverwork

The hammered sheets are frequently cut up into pieces of the proper shape and size to suit the article under construction. A cold chisel, tinner's snips, or old scissors may be used for this purpose. Rough edges are then filed or smoothed off with fine emery paper. Decorations may be stamped or cut on the surface with tools made from old files. After the decoration has been applied, articles like rings or bracelets are bent into shape over mandrels, pieces of wood of the proper size.

Soldering

The Navajo silversmith visited by the writer used neither blow pipe, torch nor a soldering iron such as is used by jewelers, yet he was able to solder bands of silver to bases for mounting turquoise and other stones, also for attaching stick and bar pins to silver work. A piece of fine wire (removed from a discarded piece of window screen) was wrapped around the pieces of silver to hold them in place until bits of solder melted and flowed around the seam to be soldered. Pieces of fast flowing hard solder were placed adjacent to the parts to be soldered, powdered borax was sprinkled over the solder and held in place with saliva. The article secured by the binding wire was placed over the forge, and the heat raised gently until the solder melted and flowed to the desired points. After cooling the binding wire was removed, and the article was ready to be whitened or cleaned.

Cleaning

The silver will darken while being worked, and will require cleaning before it is polished and made ready for mounting the turquoise.

Into the copper vessel, (made out of the copper bottom of a discarded wash boiler, folded into the shape of a small box). water and a piece of alkaline earth, Almogen, according to Washington Matthews, is placed and brought to the boiling point over the forge. The alkali causes the water to effervesce, and into this the silver is placed, and the boiling continued for a few minutes, or until the entire surface of the silver becomes bright and clean.

The silver may be rubbed with a piece of highly polished steel, and burnished bright, then rubbed on cloth or buckskin on which has been sprinkled fine wood ashes.

Mounting Turquoise

Each stone to be mounted is carefully fitted to the metal band which is to encircle it before it is soldered in place. The stone is afterwards slipped into the metal band, the edges of which are crimped over the stone to hold it securely in place. This is usually done with pliers. Sometimes the upper edges of the metal band are serrated with a triangular file and each little tooth is then crimped over the stone. The shaping and polishing of turquoise is described in the metal work section on silver.

Concha Button and Hollow Bead Making

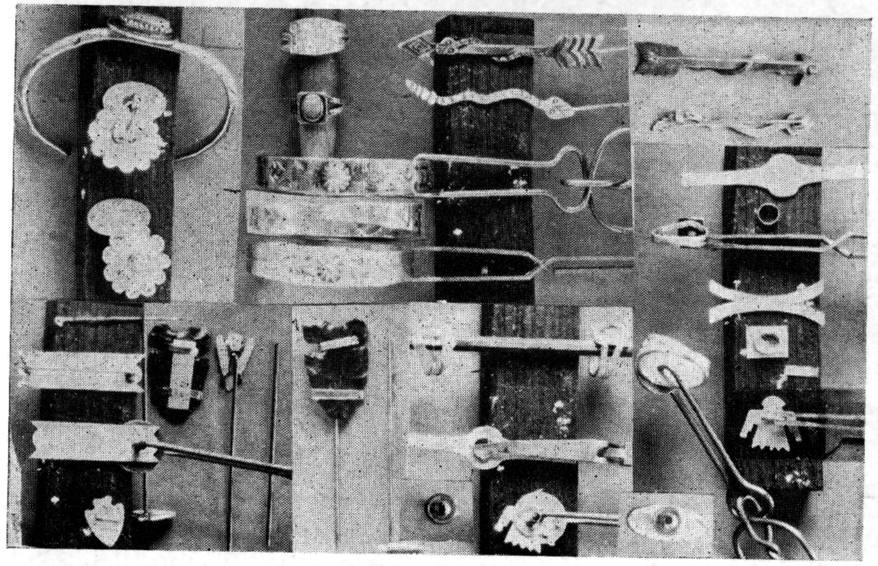
The hammered sheet made from circular ingots or cut from larger pieces, are given a convex shape by using a round end die and a concave matrix. The die may be the end of a rod or bolt with the end rounded. The matrix is usually a concavity in a piece of metal or hardwood. The metal is worked into one of the larger matrix by hammering the silver with the die. Reheating and working in smaller matrix follows until the desired size has been obtained.

In making hollow beads, the shaped silver hemisphere is set into a concavity of a piece of wood and the rough and protruding edge ground down by filing or by rubbing on an abrasive. Holes may be drilled with the pump drill, or made by driving the tang of a file thru the metal. The beads are strung on wire concavities facing together, and soldered by the method already described, several beads being placed on the wire at one time. Conchas and buttons that are not perforated, will have a loop of wire, or other strap, (usually of copper) soldered to the back, for attaching them to leather.

Silver Working Projects

In the accompanying photographs are shown several articles, which are suitable for the Camp Handicraft Program in Silversmithing.

The Cast Bracelet shown in the upper left is made from one-half of a Peso (Mexican Dollar). The ingot is cast in a V shaped groove about 4 inches long. The groove is about 3/16" deep and ¼" wide at the top. The triangular shaped ingot is drawn out to a length of about 5¼" by hammering it on an anvil or a piece of railroad iron. The anvil contains a V shaped file cut in which the ingot is placed to preserve the shape during the drawing process. The center of the ingot is flattened to receive the band which holds the turquoise. The soldering, cleaning and mounting of the turquoise has been described.



Charcoal Making

The Indian makes his own charcoal. His method may be readily followed in camp and the process made a Camp Fire Ceremony conducted by the Camp Silversmith. After the Camp Fire has burned to coals, and the fire has ceased to smoke, but before the burning logs have broken up, quickly smother the fire with moist earth. Let the earth remain on the coals until morning and the charcoal is ready for use.

The Cast Ring

The ring shown to the right of the bracelet is made from about one-sixth of a Peso, and is cast in a diamond shaped mould about 1x¼" and ⅛" deep. The ingot is drawn out until it is 2½" long and about ½" wide, a stamped decoration is applied, and the metal bent while cold around a wooden stick. The ends may be soldered, or left open, like the bracelet, as desired. Many rings are left open at the ends, or drawn out quite thin and overlap to form a continuous band. This allows the ring to be readily fitted to the wearer.

The other projects shown are made from the hammered plates or the commercial sheet silver, which may be cut out with a cold chisel, and filed to the finished shape. Stick pins, bar pins, and catches are attached by soldering. Two methods of mounting arrow heads are suggested. The use of binding wire for holding parts together during the soldering operation has been described. Spring forceps, and pinchers, are shown holding parts to be soldered, when using the blow pipe flame and a charcoal block. Wire loops, metal prongs, and snap fastener parts are readily soldered to silver articles to be attached to leather.

Tool Making

Metal stamping tools are made as follows:

Heat the ends of the tool steel to a dull red, and then hammer into shape. This heating will also soften the metal, and it may be smoothed by filing. After the desired shape has been obtained, smooth any uneven places with a fine emery cloth or by rubbing on an oil stone.

To temper, i. e., restoring the tool to its original hardness, reheat the tip of the tool to a dull red glow, and dip the tip end about half of the heated portion into water. Remove it at once, and observe the color of the tip as the heat from the upper portion descends. The color will change.

The quenching of the red hot tip has cooled off the entire tip, and it will have a metallic color, which will change as the heat descends.

As soon as the light yellow or straw color appears on the extreme edge of the tip, plunge the tool into water, and leave until cold. The tool is now tempered and ready for use. Commercially made tools are polished and sometimes nickel plated after the tempering process is finished.

Indian Symbols

The symbols shown here are a few of the Trader designs used by the Pueblo and other Indians of the Southwest. Many designs are used as shown or modified as required. They are applied to pottery, woven into baskets and blankets and stamped on silver work. They may be appropriately used in the decoration of leather articles.


Thunderbird, Sacred bearer of Happiness unlimited.


Swastika, Good Luck.


Arrow, Protection.


Crossed Arrows, Friendship


Arrowhead, Alertness.


4 Ages, Infancy, Youth Middle and Old Age.


Cactus, Sign of the Desert


Gila Monster, Sign of the Desert.


Cactus Flower, Courtship

Horse, Journey.


Saddle Bags, Journey.


Bird, Carefree, Light-hearted


Lightning Snake


Snake, Defiance, Wisdom


Thunderbird Track, Bright Prospects


Deer Track, Plenty Game


Bear Track, Good Omen


Rattlesnake Jaw, Strength

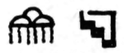

Sun Rays, Constancy

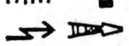

Headdress, Ceremonial Dance


Butterfly, Everlasting Life

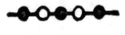

Coyote Tracks


Man, Human Life


Rain Clouds, Good Prospects


Lightning and Lightning Arrow, Swiftness


Swastika with Circle 4 corners of the world —Lake in center


Days and Nights, Time


Morning Stars, Guidance

Sun Symbols, Happiness


Running Water, Constant Life


Raindrop-Rain, Plentiful Crops


Hogan, Permanent Home


Tepee, Temporary Home


Sky Band, Leading to Happiness


Medicine Man's Eye Wise, Watchful

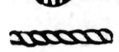

Warding Off Evil Spirits

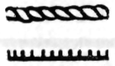

Mountain Range


Big Mountain, Abundance


House of Water


Lasso, Captivity


Fence, Guarding Good Luck


Enclosure for Ceremonial Dances


Eagle Feathers, Chief


Paths Crossing

Bead and Quill Handicraft

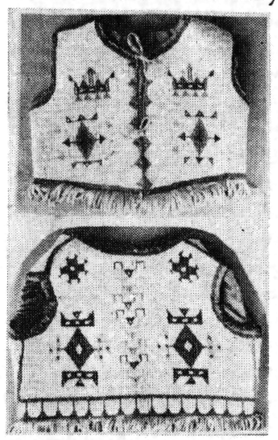
To the American Indian full credit must be given for development of the art of Quill and Bead work. Bead work is modern while Quill work is prehistoric, an art fully grown when Columbus set foot on American soil. Following the introduction of glass beads by traders, many Indians of the Great Lakes and Western Plains regions substituted beads for quills and ingeniously devised methods for using this new material in their own highly developed art of Embroidery.

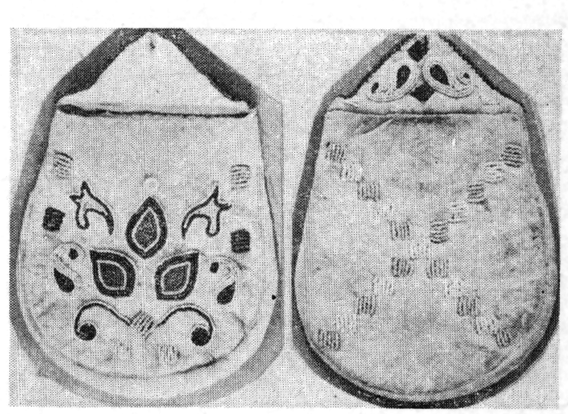
The earliest type of Bead work was embroidery and originally done upon buckskin using sinew thread. No needle was necessary, holes were punched in the skin with a bone awl (made by scraping a bone sliver to a small diameter and a sharp point). Thru these holes a stiffened sinew thread was passed.

The woven type of Bead work where a loom is used seems to be a development which followed the introduction of needles and thread. In both types of Beadwork the principle is identical. The beads are strung upon a thread which is either sewed down to the skin or strung upon the loom.

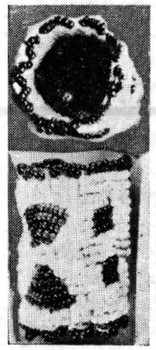
These strings of beads are laid on in parallel rows which are sewed down at intervals. When the intervals are regular a banded ridged appearance results. If irregular intervals are used a uniform surface appearance is the result.

Floral and other curved designs are made by following the design contour forming each part of the design separately. Later a background of parallel bead rows may be added.





Bead Work Design Graph Sheet

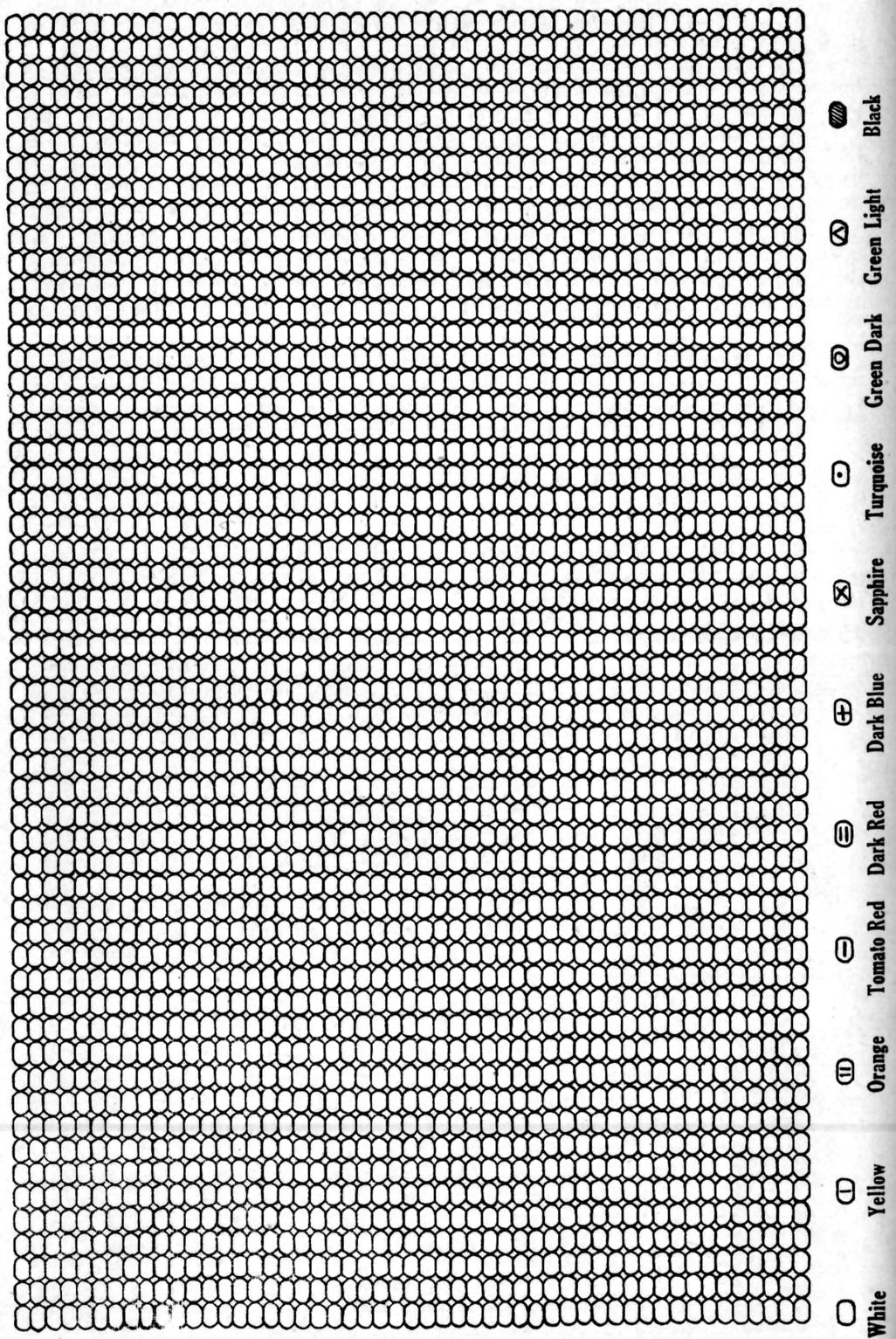


The proportions given in the graph sheet are correct for bead width and length. This makes it possible to obtain the specifications for a beaded design from a freehand sketch. Since each bead is indicated the design size, shape, and location may be determined from the sketch.

The color scheme may be worked out with colored crayon or symbolized according to the legend given below, which will be a convenience in making carbon copies of a design. Bead graph sheet is shown on page 456.

This chart when reduced one-third will be actual size for 3/0 beads. One square inch of surface beaded with 3/0 beads is eighteen beads wide by eleven beads long.

BEAD WORK GRAPH PAPER



Beadwork Technics

The technic illustrated in Fig. 2, Sketches L and L1, page 458, is known as the "lazy stitch."

The technic known as the overlay or spot stitch is illustrated in Fig. 1, sketches C and D. This is the technic employed by the Plains Indians in beading Floral elements and other curved designs. This style of beadwork is usually done on cloth or buckskin as a base, and a lining of cloth is used to conceal the stitches which appear on the lower or under side of the material.

A method of finishing the edge of a bead strip is shown in Fig. 1, Sketches A and B. This conceals the warp thread with a bead selvage. This style edge finish is appropriately used on bead strips that are not to be mounted on leather.

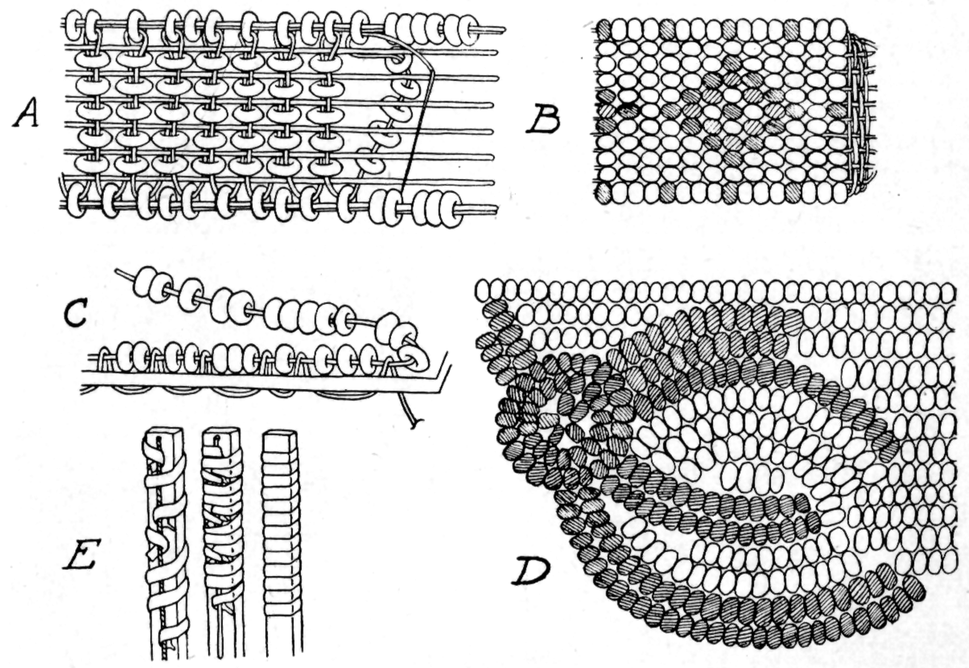


Fig. 1

The method of covering a rawhide strip with porcupine quills is illustrated in Sketch E, Fig. 1. A thread is attached to the strip, which serves as an anchor to hold the ends of the separate quills. The quills are added as shown in the central sketch, and the finished appearance is indicated in the adjacent sketch.

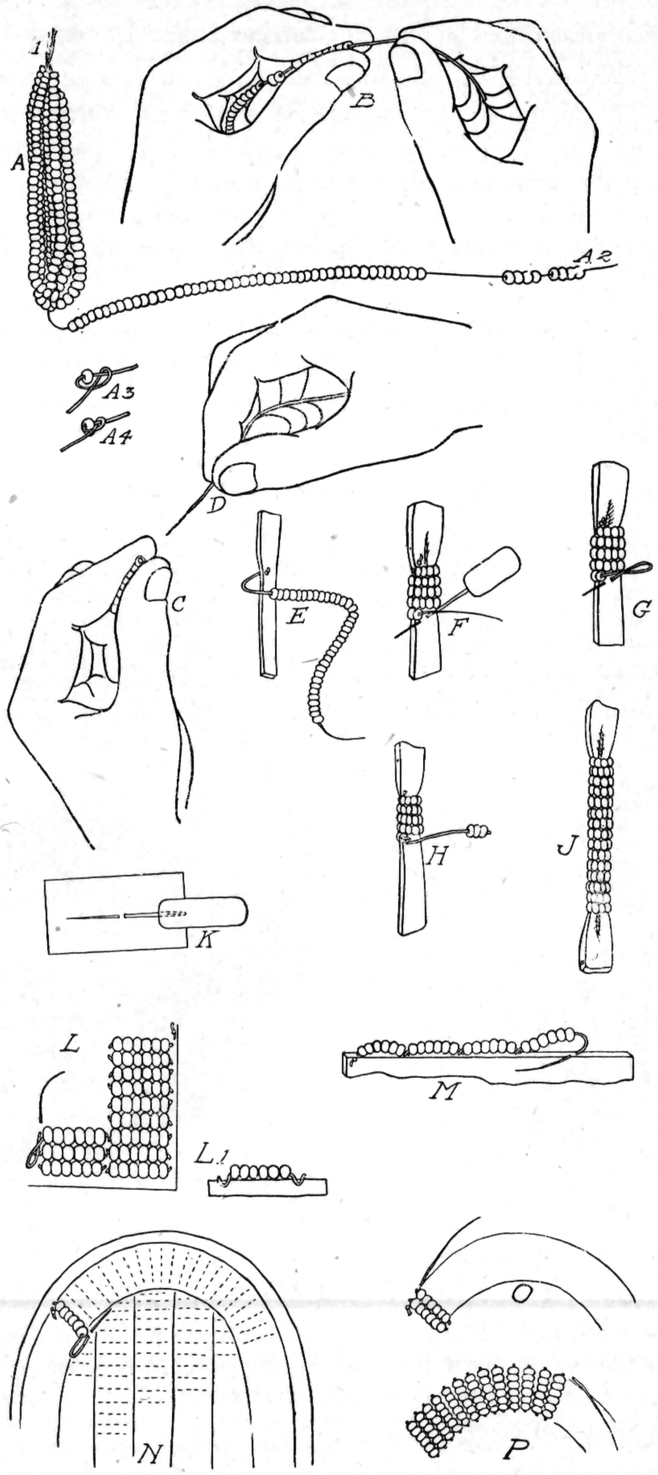


Fig. 2

Placing the Beads on the Beading Thread

The Indian method of transferring beads from the bunch to the sinew or beading thread is indicated in Fig. 2, sketches A to D. Sketch A shows the beads in the bunch with all ends brought up to the top, A-1 and secured by a tightly wrapped thread. As the beads are used one end of a loop strand is pulled out of the top as shown in A-2. This free end is grasped between the thumb and forefinger of each hand and held securely while the count is made. After the desired number of beads have been moved along the thread, they are grasped firmly between the thumb and forefinger as shown in sketch C. The sinew or needle, sketch D, is passed down thru the beads, which if held firmly, are in line and may be readily threaded.

Beading a Thong

Beaded thongs are frequently used in Indian costumes. The method of beading a thong is indicated in Fig. 2, sketches E, F, G, H, and J. The beading thread is made fast as shown in sketch E, and the thong is wrapped tightly with the beaded thread. Not more than five or six complete turns are made before securing the end as shown in sketches F, G, and H. The wrapping process is continued until the thong has been beaded for the desired length. The only tool needed when using sinew thread is an awl. Sketches F and K show an awl made by inserting a sewing needle in the end of a short stick or twig.

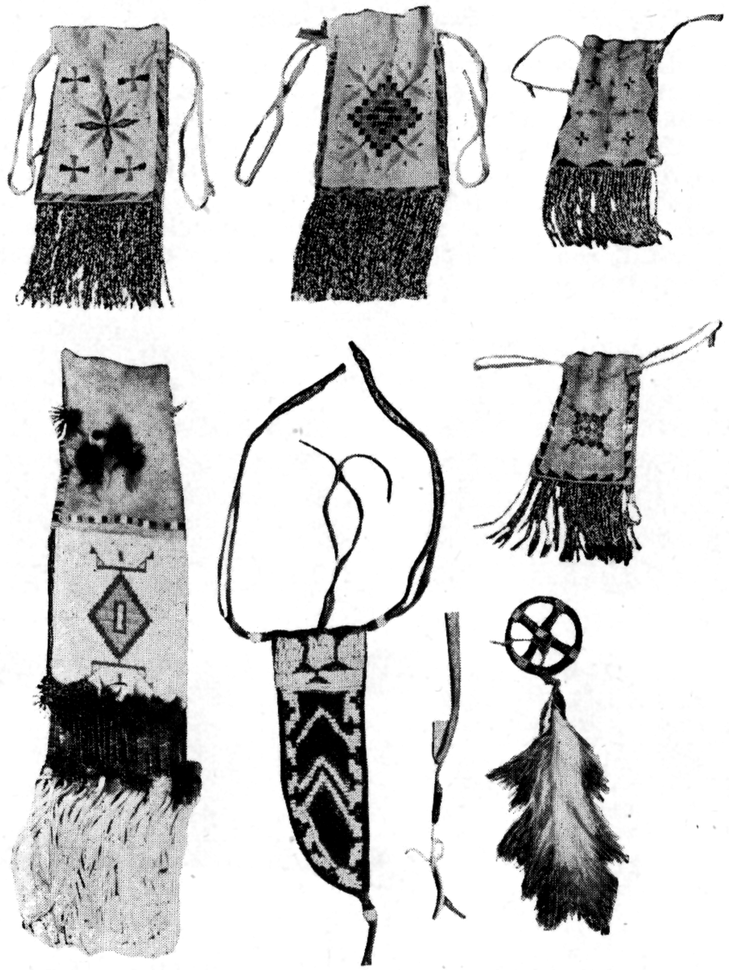
Beading a Leather Surface with Parallel Bead Rows

The method of sewing down rows of beads is shown in sketch L. The number of beads between stitches may vary according to the design and will range from one half to one dozen beads. Naturally using more beads between stitches will speed up the beading process, but it is difficult to handle ten or twelve before threading them on the beading thread, and also to make them lay flat in the bead row. If beading on Buckskin the sewing down stitches may be concealed from the under surface of the Leather. The method is indicated as shown in sketch L-1. It is not necessary to go thru

the leather. The stitches may be caught thru the upper surface and anchored securely. The beads are applied to the flesh side of the Buckskin, which leaves the smooth or grain side of the leather free from stitches and smooth enough to be worn next to the skin. Sketch M, Fig. 3, page 462, shows a method of beading in parallel rows but with irregular intervals to break up the ridged appearance of equal interval beadwork.

Beading on the Edge of the Leather

The edge of leather is frequently beaded to improve the appearance of the work by covering any unbeaded areas between the surface beading and the edge. The rows of beads are sewed down end to end with the stitches concealed as indicated in Sketch M, Fig. 2, page 458.



Beading a Design on Leather

1—A border bead row or frame is marked out on the leather. See sketches N, O, P, Fig. 2.

2—The design sketch A of Fig. 6, shows details of a knife sheath design layout which may be compared with the photographic illustrations of the beaded article. The knife sheath illustrated is beaded on both the back and front. The assembly is by sinew sewing and the stitches are beaded as shown in Sketches B and C, Fig. 6, page 461.

Beading a Rosette

There are several applications of beaded Rosettes—ornamental side pieces for War Bonnets, Bag and Pouch decorations, etc. The original rosette designs done in porcupine quills were made of concentric circles or bands of quills. The same type of bead row bands are frequently used, in making rosettes. Another type of rosette is shown in sketch J, Fig. 3, which is made in the manner of beading the Rabbits Foot. The beading thread takes a zig-zag path, and each additional bead should be securely anchored to the preceding bead row. Periodically the beading thread should be sewed down to the leather, since it is only attached to the central circle. A rosette built up of concentric circles is shown in sketch K. The rosette shown in sketch L is a spiral which is sewed down to the leather at irregular intervals. Frequently this type of rosette is beaded between radial lines, in which case the beaded rows vary in length to fit the segment.

Beading a Rabbit's Foot

There are many applications of bead work to cylindrical surfaces such as handles of Rattles and Clubs, Rabbits feet, etc.

The method detailed here is the one used by the Ute Indians in ornamenting a Rabbits Foot which is used as a decorative pendant which dangles from a thong emerging from the center of a rosette on a head dress.

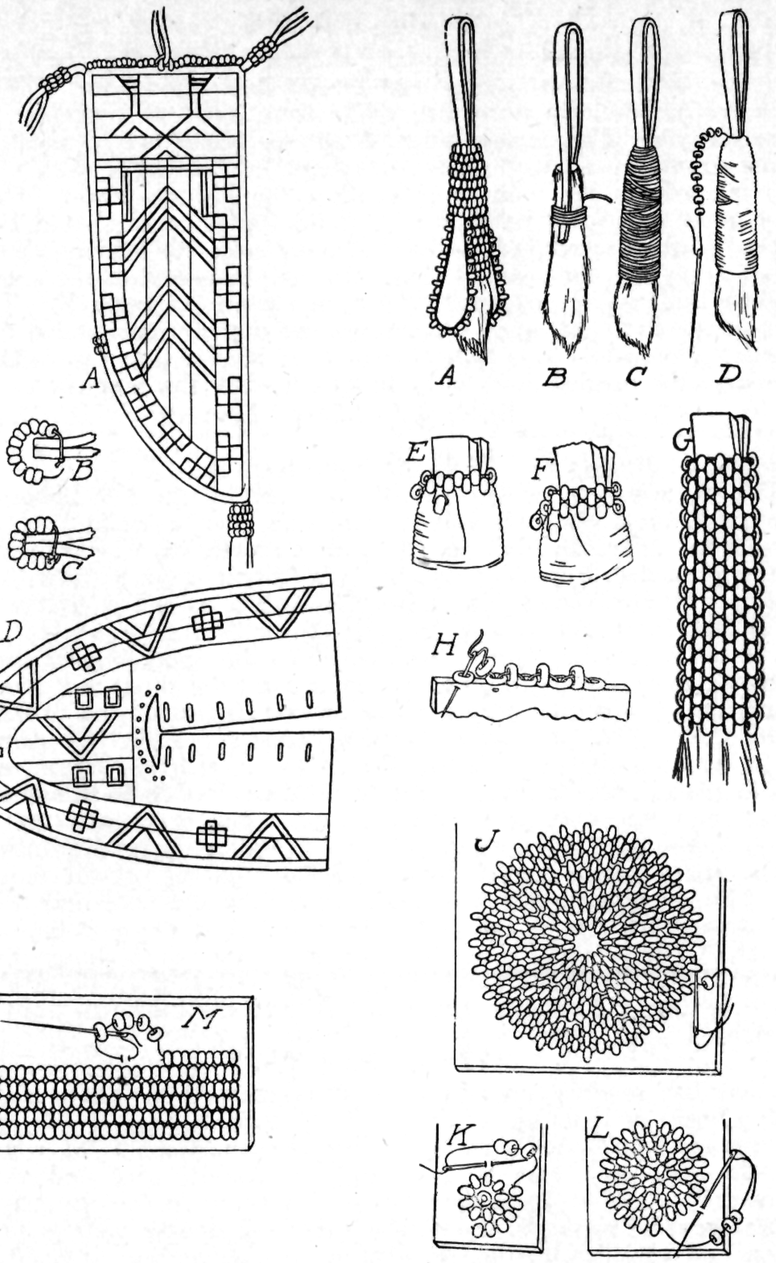
The procedure in making up a beaded Rabbits Foot is shown in sketches A to H, Fig. 3. A thong, usually of buckskin, is sewed to the skin of a dried Rabbit Foot and wrapped with string or cloth as indicated in sketches B, C, D. The beading thread is attached to the upper end of the wrapped surface. Enough beads to go half way around the thong are strung on the beading thread, and one wrap is made around the upper end of the wrapped Rabbits Foot. One by one additional beads are added by drawing each bead in between the beads in the first row. Sketch E shows two rows of beads in place, and the start of the third row. Sketch F shows three rows in place and the start of the fourth row. The principle is to carry the beading thread in a zig-zag path thru each additional bead, which is drawn into the space between each bead and the adjacent one of the preceding row. The cylindrical sleeve is built up around the core and need not be sewed down to the core except for the addition of the two flaps as shown in sketch A, and at the end of the Bead work. Sketch G shows the diagonal patterns of the Bead work which is readily adapted to designs having a spiral base line. The edge beading detail on the buckskin flaps is shown in sketch H.

Woven Bead Work

There are several types of Bead Weavings, each requiring some form of weaving frame or loom on which parallel threads (warp) are stretched. The cross threads (weft) of beads are woven into the warp. The weaving may be single warp and weft, single warp and double weft, and with special equipment (a heddle) for manipulation, double warp threads may be used. Of these several methods, the single warp and double weft is perhaps the simplest and speediest method to employ in making beaded bands.

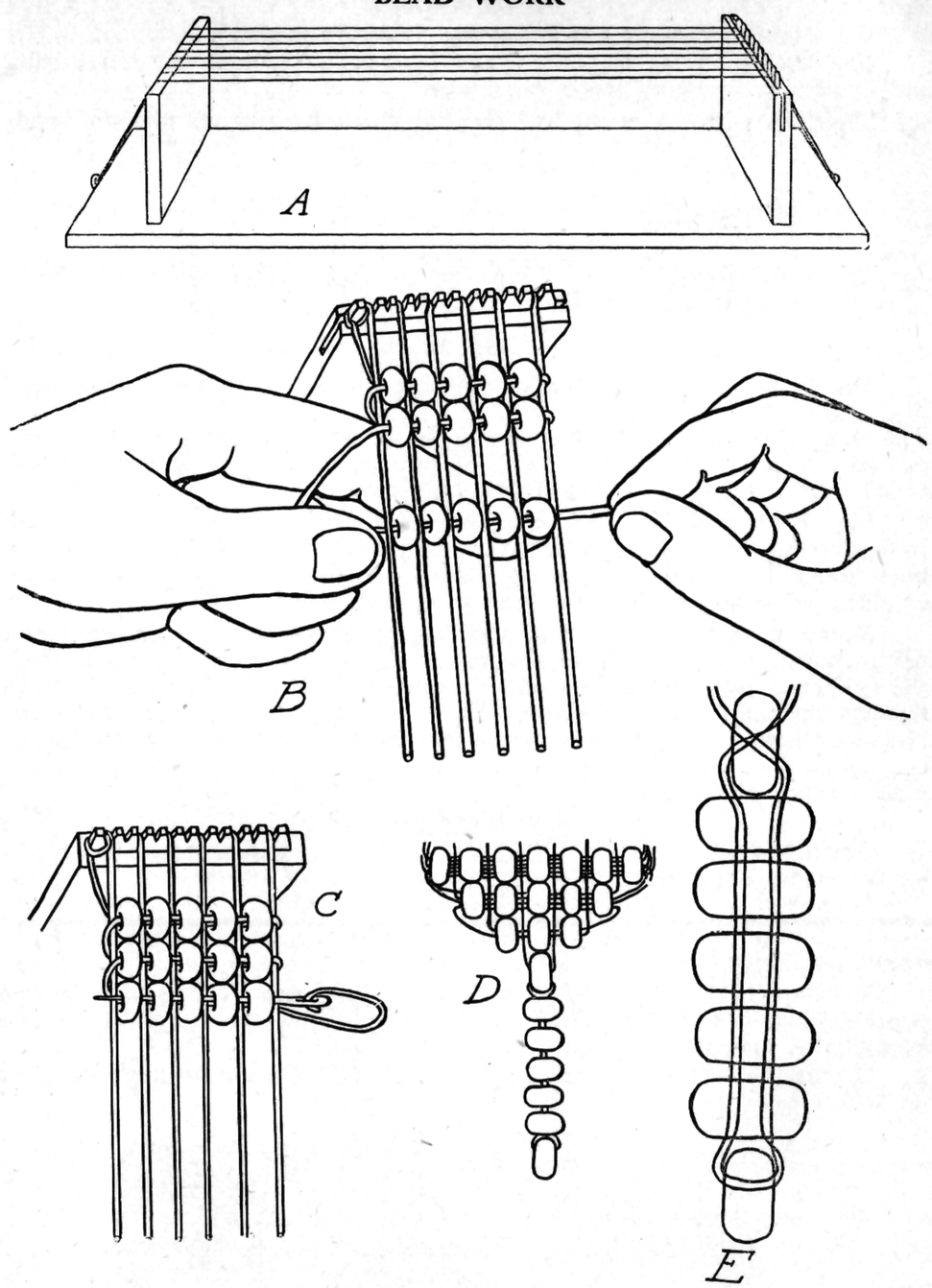
Loom Construction

A simple loom is required. The one illustrated in Sketch A, page 463, consists of a base board on which two upright pieces have been nailed. One of the upright pieces has a saw cut about an inch deep cut in the upper edge. Into this cut a fine toothed comb is placed. A nail or tack is driven into each end of the base board. The loom is strung by making one end of the thread on a spool fast to the nail in the base board and carrying the thread up over the upright between the teeth of the comb across the top of the other upright and around the nail in the other end of the base board, then back to the starting point the required number of times to make a beaded band of the desired width and length.



The method of transferring the beads from the bunch stand to the beading thread has been described. The method of placing them on the loom here described is known as the single warp, double weft method. This means that there are two threads passing thru each row of the beads. A simple procedure in doing this is to pass the beading thread on which the proper number of beads have been strung under the warp. Press the beads up between the warp threads as shown in Sketch B, page 463. The beads are then held firmly in place, while the needle of the beading thread is passed thru the beads over the top of the warp. The beading thread is pulled up taut, and each row of beads is firmly and securely attached to the warp.

The beaded band may be ended in several ways, depending upon the use for which it is intended. Arm bands, garters and sashes may be appro-



priately ended with a bead fringe. The detail of making a bead fringe is shown in Sketch E, above. The warp threads on each side of the last bead are passed thru the end bead from opposite sides and carried down thru the bead strand to the end of the fringe. Again the two warp threads are passed thru the end beads, and back up thru the fringe strand, where each may be cut off or returned thru the fringe strand if space permits for rethreading. Each warp thread may be terminated in a bead fringe by rethreading the fringe beads twice or three times depending upon the bead size The idea is to fill the beads with thread to give added stiffness to the fringe.

Ending and Mounting Loom Beadwork

The accompanying sketches show construction details for terminating and mounting beadwork made on a loom.

Sketch A shows a method of securing the warp threads in loom beadwork.

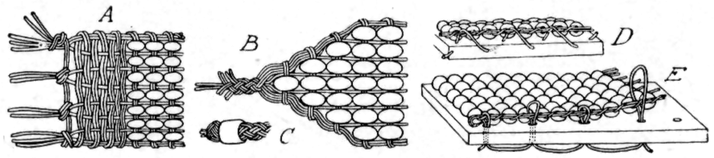


Fig. 17

Sketch B shows a method of finishing the end of a loom work bead strip that is tapered to a point and is suitable for necklaces and watch fobs. The warp thread is brought together in bundles of equal numbers and plaited into a strand. A tube bead may be slipped over the strand which is ended with a terminal Turkshead, described on page 107.

Sketch D shows a method of applying a strip of loom made beadwork to buckskin. The end of the warp threads are concealed by folding them back under the beads and then stitching across the end with the same style of stitch as is shown along the side as in sketch D.

Sketch E shows a method of applying beadwork to strap leather. Holes are punched ¼″ to ⅜″ apart and the seizing thread is passed up through the end hole, over the double outside warp thread and carried back down through the same hole in the strap. This same procedure is followed for the remaining holes. If a groove is cut on the under side of the strap, the thread resting in it is partially concealed, and protected from the wear on the inner surface of the belt.

Tube Bead Mats

The mats shown in Fig. 20 are suggestive of a few desirable shapes for use under hot plates.

A method of assembling these mats is given below.

1. String beads 1 and 2, Sketch B, Fig. 21, on a thread having a needle on both ends.

2. Pass both needles through bead 3. Then pass each needle through separate beads 4 and 5. Again pass both needles through bead 6, and continue as indicated through beads 7-8-9-10 and 11.

3. Proceed with one needle from bead 10. Pass it through bead 11 as shown in Sketch C.

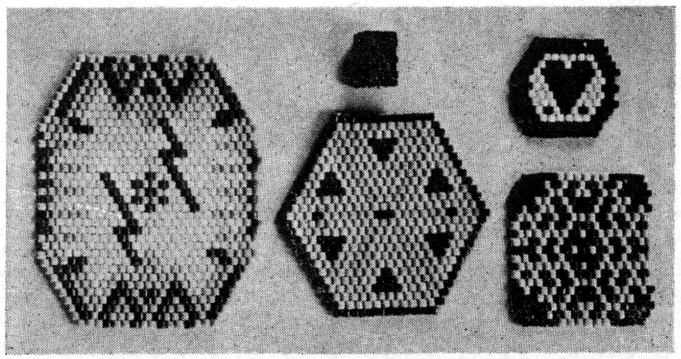


Fig. 20

4. Continue with one needle—adding beads in the numerical order shown in Sketch D. The thread passes through the bead 12, 8, 13, 5, 14, 2, 15, 14, 16, 13, 17, 12, 11, 18.

5. Taper the edge of a mat by omitting a bead in the outer rows as shown in Sketch D, Fig. 21. Thread the beads as shown through 18, 12, 9, 11, 18, 19. See Sketch E for a continuation of this method of threading 19, 17, 20, 16, 21, 15, 22, 23, 20, 24, 17, 20, 13, 17, 24.

Tubular Neckerchief Slides are readily made by joining the outside edges of a rectangular bead mat containing an odd number of bead rows by adding one bead to each even numbered row.

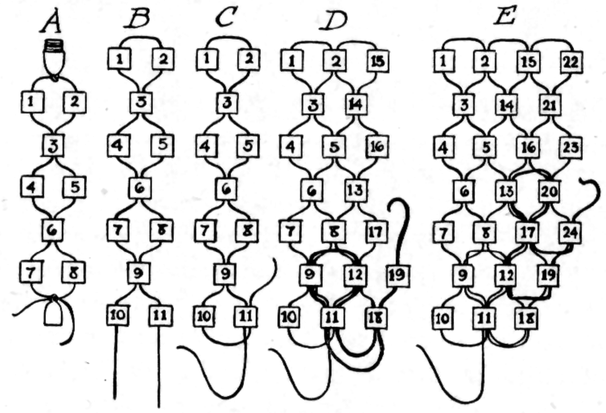
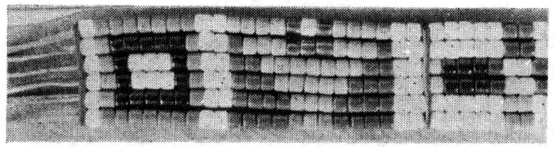
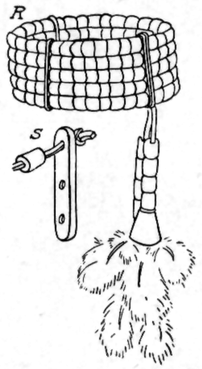


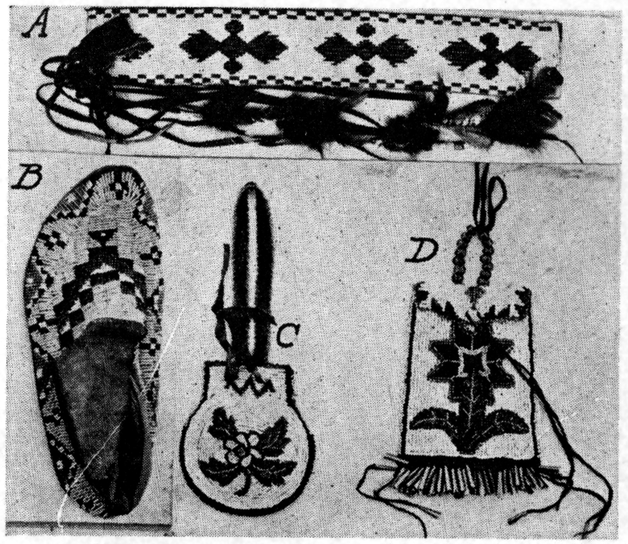
Fig. 21

Arm Bands



Armbands, Necklaces, Breastplates, are appropriately made from tube beads. The armband shown in sketch R is made of tube beads strung on





a leather thong, and each strand is held in position by strap leather spacers shown in sketch S.

The thongs supporting the fluffy pendant attached to the armband, sketch R, may be decorated with tube beads.

Necklaces

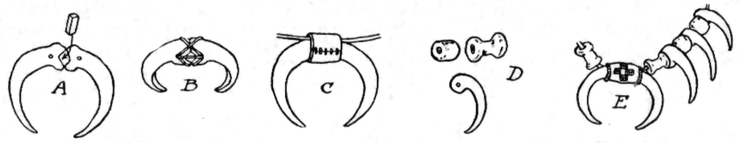
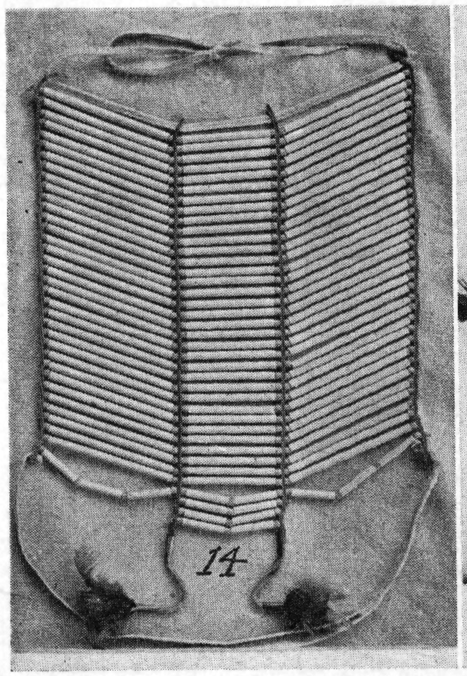


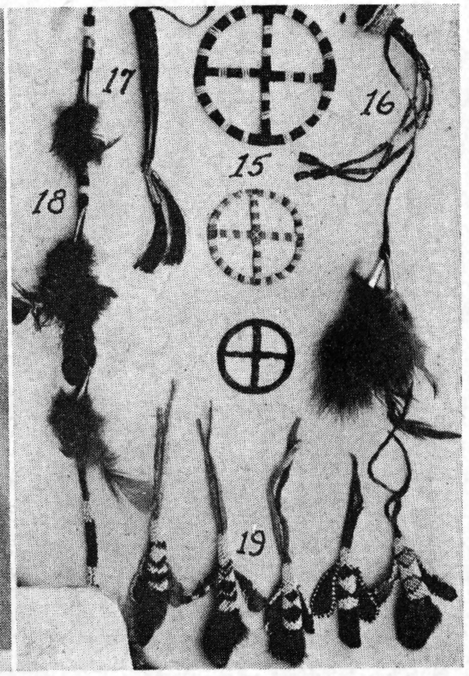
Fig. 10

The necklace shown in the photograph is made from Eagle and Hawk talons. The talons are prepared by trimming off all cartilage and drilling through the base as indicated in Fig. 10, Sketch D. The crescent is made by joining two talons together with waxed thread as shown in Sketch A and B. A square peg is inserted in the space between the two talons as indicated in Sketch A. Bone spacers of the shapes shown in Sketch D were made from bone section, see page 444, and drilled with a pump drill. The center of the crescent is covered with buckskin and beadwork attached with sinew. The bead string is passed through under the buckskin and the bone spacers and talons are assembled as indicated by Sketch E. The large flat oval beads are made from the seeds of tropical plants.

Breast Plates

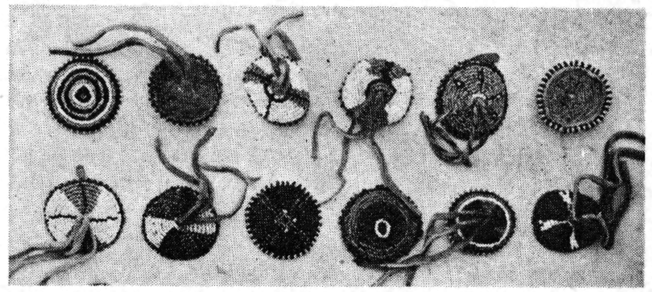
The breastplate shown in the photograph is made of tube beads held in place with straps of leather perforated to suit the desired tube spacing.



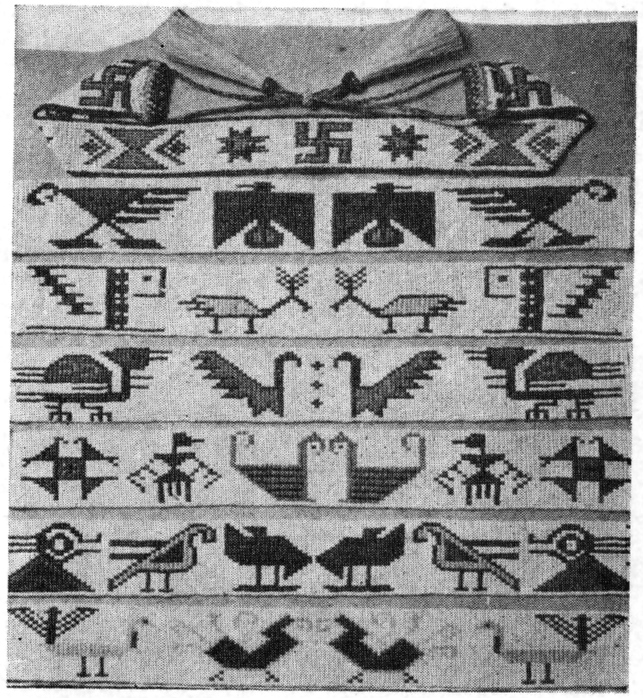


ROSETTES

The detail for making a bead rosette is given on page 461.



The illustration below shows a beaded hat band with horse hair tassels, described on page 430, and bead strips ready for mounting as detailed on page 464.



PORCUPINE QUILL HANDICRAFT

Quill work is rapidly becoming a lost art among many of the Plains Indians. Many exquisite pieces of quill work are to be found among collections made thirty to forty years ago.

Quill decorations may be either laid on in rows or bands or woven on a loom. Only the banding decoration is shown here. The method of quill decoration presented here was obtained by the writer from the Sioux Indians of the Pine Ridge Reservation. The art was unknown to many of the younger squaws. The methods obtained have been checked with the technique of quill work to be found in the American Museum of Natural History.

Banded Quill Work—Porcupine quills are dyed very much in the manner of dyeing Easter Eggs. Just before using, the quill must be softened and flattened. Quills soaked in warm water until softened may be flattened by rubbing with a smooth piece of wood. The squaws carry a few quills in the mouth when doing quill work and this softens them as they use them. The flattening process is equally simple. They hold the tip end of the quill between the teeth, and pinching it tightly between the thumb nail and the forefinger pull it through the fingers to the other end of the quill, by moving the hand outward from the teeth. Two or three times will suffice to flatten a quill sufficiently. The quill is attached to the leather by a concealed stitch The sketches A to K, Fig. 4, show the process in applying a quill band to buckskin two needles and thread also an anchor thread are used. The anchor thread is for convenience shown attached to a nail, sketch A, driven into a board near the piece of leather. The squaw ties the anchor thread to her foot while applying the quills to a moccasin upper held in her lap. She does not use a table but holds the work in her lap while sitting on a blanket in her tepee.

The base end of the quill is placed under the lower thread as indicated in sketch A. The needle is inserted as close to the side of the quill as possible and the thread is thrown over the point of the needle as shown in sketch B. After pulling the thread taut the quill is securely anchored and the stitch appears as shown in sketch C. The quill is then folded across the threads, sketch D, and again folded back under all the threads as shown in sketch E. The upper needle is inserted underneath

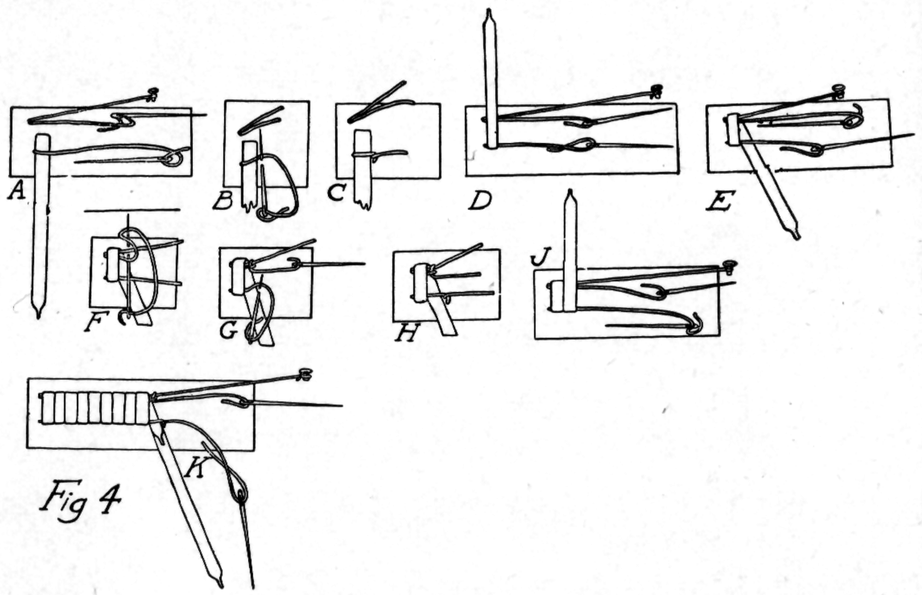


Fig 4

both the anchor and the upper thread as close to the quill as possible and after the thread is pulled taut the stitch appears as shown in sketch G. The quill is secured by the lower thread, sketch H, and the process is repeated. Sketch K shows the method of splicing another quill into the band. A quill band is ended by cutting the free end off, so that it will come to the middle of the band when folded under and pressed back in line with the top quill. This conceals the end completely. A design is worked out by changing the color of the quills.

Wrapped Quill Work—Quill wrapped thongs of buckskin and rawhide strips are used in Indian dancing costumes. A quill wrapped rosette for a war bonnet is shown in Fig. 5. An arm band of rawhide, quill wrapped and decorated with pendant fluffy feathers on quill wrapped buckskin thongs is shown in sketch D, Fig. 5.

The method of securing the quill end is shown in sketches A and B. The core which may be a strip of buckskin or a thong is wrapped with the quill as shown in sketch C. The method of splicing in another quill is shown by sketches D, E, and F. The wrapping is continued as shown by sketch G. The method of securing the end of a quill and ending the wrapping operation is shown in sketches H, J, and K. A loop of thread is placed under the last quill loop and the end of the quill is inserted in the thread loop and pulled back under the quill loop. This seizes the quill and holds it securely.

The finished appearance of the quill wrapped core is as shown in sketches L, Q, and R.

The construction detail of the quill wrapped rawhide arm band is shown in sketches N and O. The wide rawhide strip is slit so as to give a banded appearance when quill wrapped.

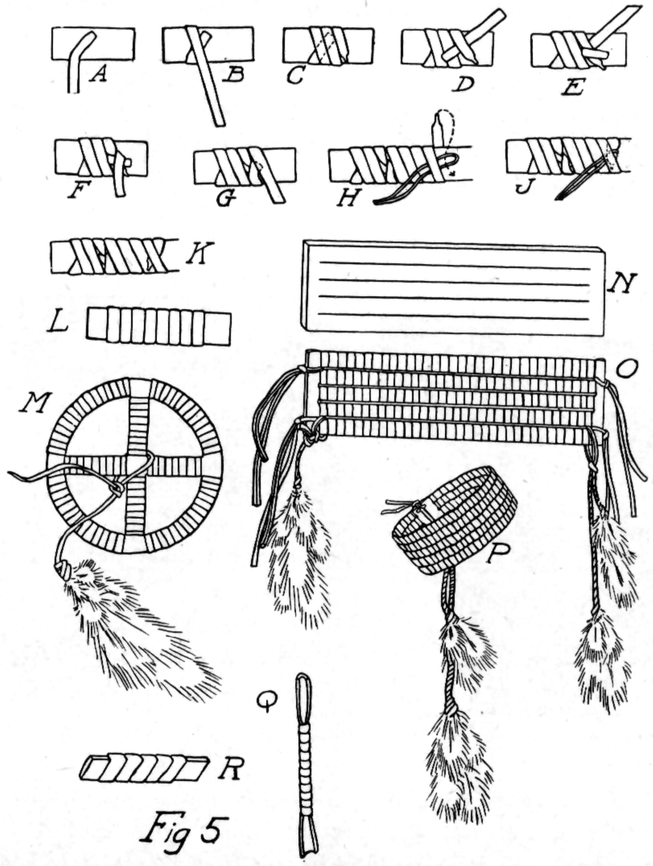
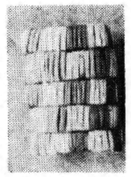


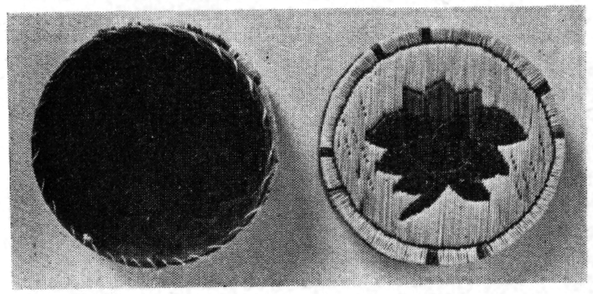
Fig 5

PORCUPINE QUILL WORK

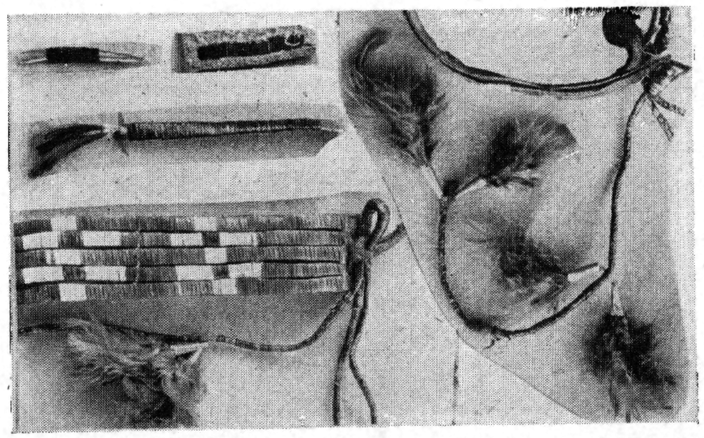
Quill Neckerchief Slide

The porcupine quill wrapped neckerchief slide shown in the photograph was made by Field Scout Executive Leigh M. Nisbet of Boston, Mass. This slide is one of his projects in Indian Lore, and may be constructed from the Quill work detail on page 468. A piece of rawhide 3″x1½″ is slit in the same way as the arm band, in Fig. 5, wrapped with the quills, laced as tube type slide, page 82, and then lined with a smooth piece of leather to protect the ends of the quills, and offer a smooth surface for the neckerchief.





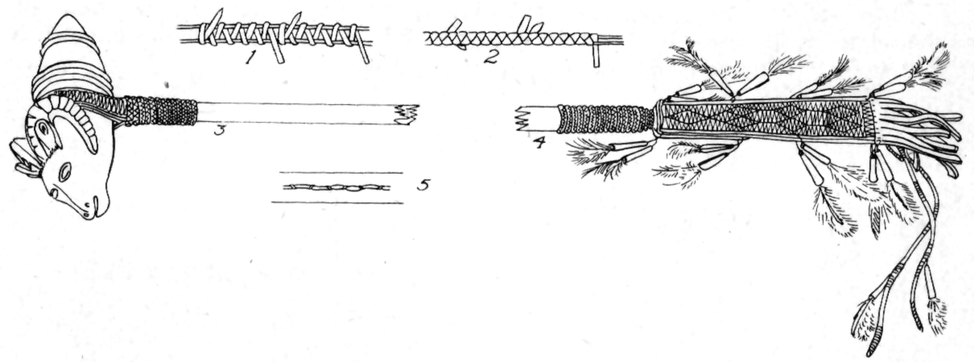
The quill covered box shown above is made from strips of birch bark. The bark is pierced with a fine pointed awl in two places. Each end of a quill is inserted in the awl holes which are pressed through the bark. The quills are softened in water to insure bending without breaking. The protruding quill ends are cut off on the inside of the box and a lining of birch bark is inserted to conceal them. The boxes are assembled with needle and waxed thread.



PORCUPINE QUILL WORK

Another form of wrapped quill work is shown in the illustration of a Sioux War Club, Sketches 1 to 5.

This piece of craftwork is the handwork of skilled artisans. The head, carved in pipe stone, is lashed to the handle with wide strips of rawhide. The outer strip of buckskin is covered with quill embroidery. This form of ornament is used on the buckskin pendant attached to the handle. The handle, made of wood, covered with rawhide, is wrapped with a strand of quill covered cord.



Sketch 1 shows how the softened quills are applied to the foundation cords. The method of securing the ends of the quill, also splicing in additional quills is clearly shown in this sketch. The cords are purposely shown with a space in between to indicate the zig-zag path of the quill. Actually the cords are drawn close together as the wrapping progresses. The appearance of the quill covered cord shown in Sketch 2 becomes a band of quill work about an eighth of an inch wide and approximately one thirty-second of an inch in thickness. The band is applied to the handle of the war club as shown in Sketches 3 and 5. Sketch 4 shows a detail of the stitch used in joining the edges of the rawhide covering the handle.

Hair Craftwork

The hair headdress or roach (the Cha-cin-ger-ra) as it is known to the Sioux has been a favorite ornament in the wardrobe of Eastern and Plains Indians for many generations. Where it originated is apparently unknown. Catlin, the historian who contacted the Iriquois in his early explorations, shows this form of headdress in his illustrations. Maximilian shows Sauk and Fox Indians wearing **Deer Tail Roach Headdresses** in his atlas. The specification given here is taken from a handsome roach made by a Sioux on the Pine Ridge Indian Reservation in South Dakota.

The primitive materials used consist of deer hair—both the short body bristles and the long hair found in the tail, porcupine hair and the hair of mountain sheep and goat. These are attached to a stout cord as indicated by Sketch 2. The technic employed consists of:

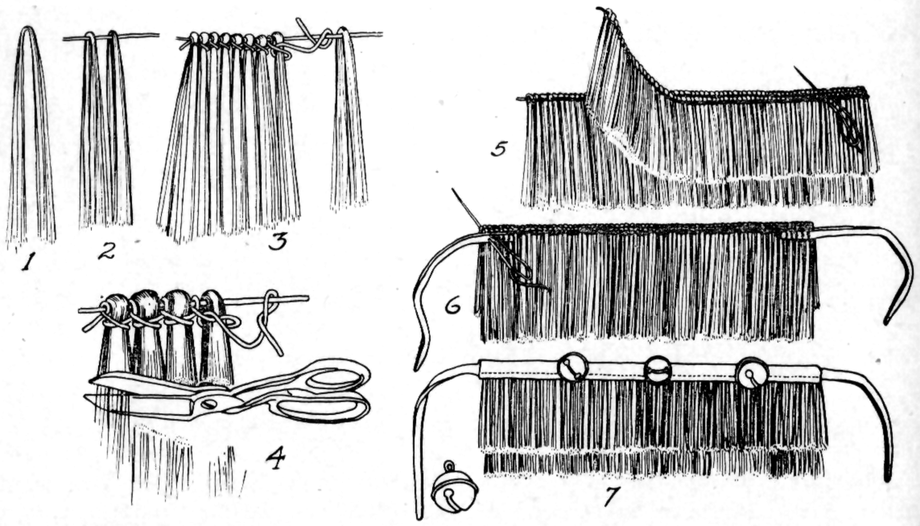
1. Looping a wisp of hair over a stout cord stretched taut as indicated in Sketches 1-2-3.

2. Seizing each bundle of hair with a strong thread half hitched around the bundle, see Sketches 2 and 3, also Sketches 3 and 4.

3. Trimming the ends of the hair bundles to the desired length.

This technic produces the foundation used in the construction of anklets and rosettes as well as the Roach. We shall describe the construction details of the more elementary project first.

Hair Anklet



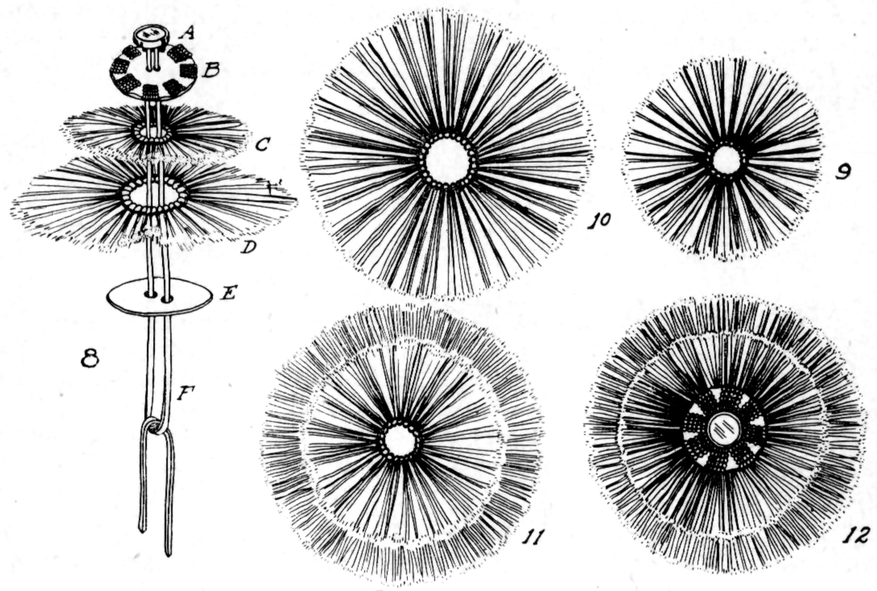
1. Unite two lengths of foundation cords by sewing together with needle and thread as indicated in Sketch 5. These two cords should contain hair loops of unequal lengths and hair of different colors if desired.

2. Sew thongs or tie straps to each end of the foundation cord. See Sketch 6.

3. Cover the selvage edge of the foundation with buckskin or colored flannel and attach sleigh bells as indicated in Sketch 7.

Hair Rosette

1. Form a disc by uniting (sew or tie together) the ends of a foundation cord. See Sketches 9 and 10.



2. Mount two or more discs of different diameters as indicated in Sketch 8 by passing the ends of a thong (attached to a concha, mirror 8-A or other ornament) through a piece of leather (beaded buckskin 8-B) then through the hosehair discs C and D and another piece of leather 8-E. Draw the thongs taut and secure the assembly with a knot in the thongs.

These assembled rosettes are worn on head bands, arm bands, and leg bands, also as centers for dance bustles—see Kiowa dancer.

Hair Roach

1. Unite several lengths of short clipped horsehair or deerhair (Sketch 4) foundation cords by sewing together with needle and thread as indicated in Sketches 4 and 5.

2. Build foundation cords. Use long deer hair—both light and dark red; long porcupine hair, natural; short clipped horse hair, natural as indicated in Sketches 2 and 3. Hemp may also be dyed and used with the same techniques employed by the primitive Indian craftsman. In case primitive materials are not available, use colored angora goat hair—light red, dark red.

3. Assemble the roach by adding foundation cords to the original pair, Sketch 4, which encircles the loop from which protrude the two thongs, see Sketches 14 and 20. These are ties which fasten under the chin and hold the roach in position on top of the head.

The inside foundation cords are made with natural color deer hair clipped short, as indicated in Sketch 3, and sewed together as indicated in Sketches 4 and 5.

The fourth cord from the edge is made with long porcupine hair, natural color, about 5½ inches long. The third cord is made of long deer hair dyed light red. The second cord is closely trimmed short deer hair. The outside cord is made of colored angora goat hair 2 inches long, dyed red, and extends entirely around the roach. The assembled roach showing the manner of placing the foundation cords and tie thongs is indicated in Sketch 1.

This assembly is flexible and conforms to the contour of the head when tied in place. Cords A and B tie under the chin, while cords C and D tie around the neck. In several museum pieces examined, the cords A and B are omitted. Students of Indian Lore believe that the roach was held in place by locks of hair passed through the hole and tied together.

Roaches are sometimes decorated with one or more coup or exploit feathers. The primitive method of attaching these feathers to the roach is another bit of Indian ingenuity. In fact, the roach is a masterpiece of the master craftsman. Artistic appreciation for native material, skill of the highest order in their utilization—influenced the design and development of this type of headdress. The achievement of all the objectives of beauty and utility have been realized and expressed through this creative bit of handicraft.

The original device for supporting the feather was a swivel attachment made from a piece of bone. The feather was held upright within the bone holder and free to spin about in the wind. The bone holder was attached to the roach by thongs passing through holes drilled near its base.

Roach-Swivel Construction
Single Feather Mounting

Wood, bone, horn, or leather may be utilized in the construction of this attachment, sketched on page 475.

1. Form a cone-shaped cavity in the material selected for the feather holder as indicated in Sketch 6. In case heavy weight leather is available, shape the holder to fit the diameter of the feather as indicated in Sketch 8.

2. Cut off the tip of the quill as indicated in Sketch 9.

3. Shape a wooden plug as indicated in Sketch 10.

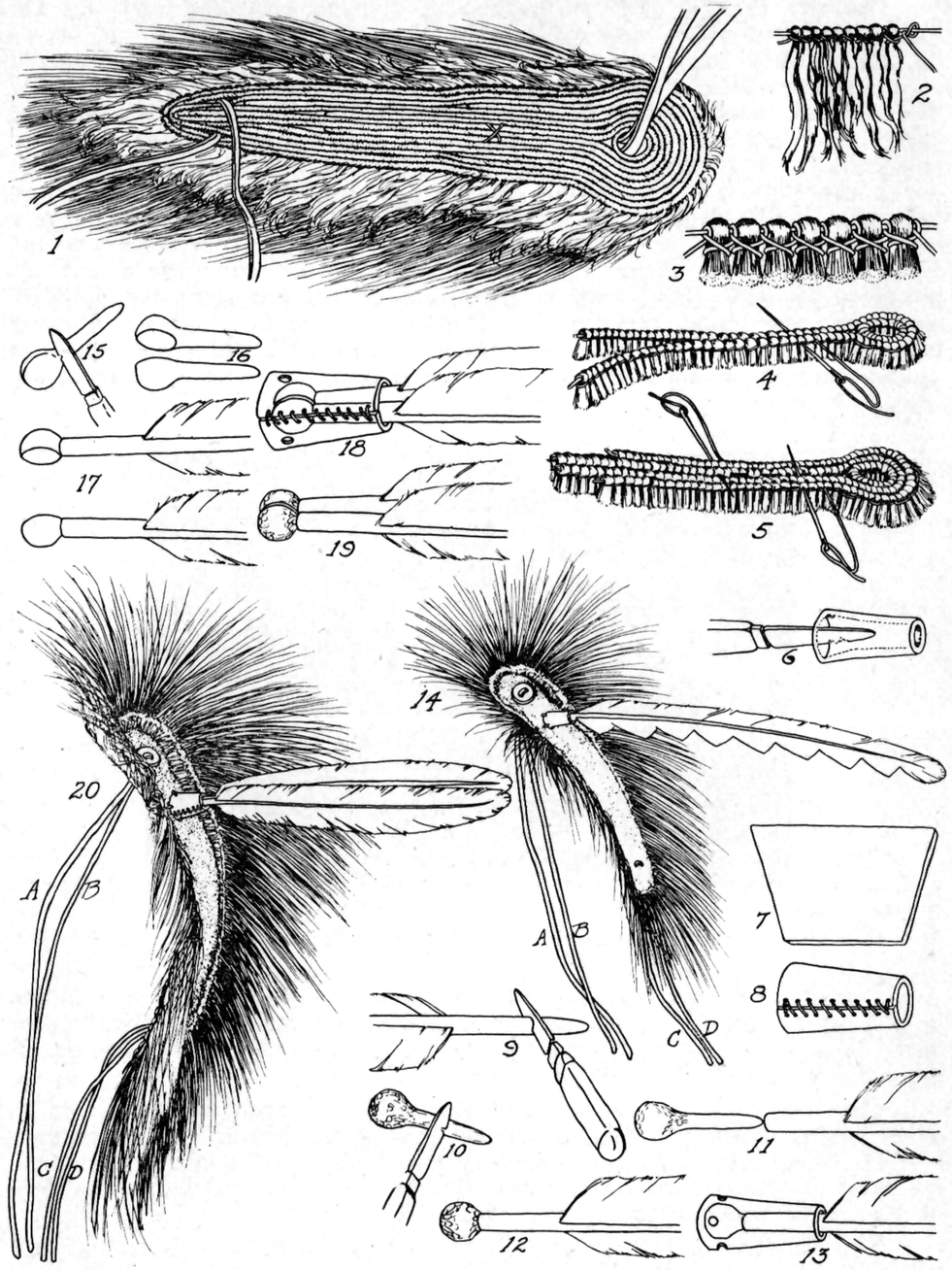
4. Insert the plug in the quill as indicated in Sketch 11. Sketch 12 shows the plug fitted in the quill.

5. Slip the holder over the quill and insert the plug which may be held by glue or seized with thread or sinew.

6. Drill holes through the base of holder (See Sketch 19) and lace the assembled feather to the roach as indicated in Sketches 14 and 20.

Double Feather Mounting

1. Shape two wooden plugs as indicated in Sketches 15 and 16. Sketch 17 shows the plugs fitted into the feather quills with the flat areas facing each other.



2. Slip the holder, made to accommodate the two plugs over the two quills and insert the plugs as indicated in Sketch 18 (with the flat faces in contact) and slip the holder into position. See Sketch 18.

3. Lace the two feather assembly to the roach with leather thongs as indicated in Sketch 20.

FEATHER HANDICRAFT

Feathers used in the construction of dancing costumes made by the Indian in his primitive state were taken from the birds found in the vicinity, or obtained from other tribes. Eagle feathers, the most highly prized of all, were used as a reward for deeds of valor and service. A complete War Bonnet made entirely of Eagle Feathers was obtained after years of effort, and rightfully belonged only to the experienced warriors and chieftains. This restriction in itself, if we but try to be truly accurate in our interpretation of the Indian, sincere and respectful of his forms and customs, should deter us in using Eagle Feathers. A greater deterrent however, should be the wholehearted desire to protect and prevent the extermination of the King of the air. Feathers of domestic fowls and unprotected predatory birds may be used with perfect propriety. By skillfully employing the Indian technique in featherwork together with such other legitimate materials as may be required, well balanced, graceful head dresses and other parts of the costumes may be created at a moderate cost.

Sioux Indians, Sylvan Lake, Black Hills, South Dakota

The simplicity of the processes employed by the present day Indian in preparing feathers for decorative purposes, and the amazing effect produced by a few feathers skillfully used, makes feather work a most appealing activity for the Handicraft group.

The few tools needed for feather work are those usually found in every home; needle, thread, scissors or shears, gas pliers. The materials—feathers of domestic fowls or predatory birds, wing, tail and fluffy feathers, coloring dyes, pieces of soft leather, thongs, horsehair, yarn, tin can, glue or household cement and sealing wax.

The elements of feather work are shown in the detailed sketches. Fig. 1 indicates the methods used by the plains Indian to attach feathers to their costumes. The sketches A to D show how to prepare a large quilled feather for mounting on head dresses, trailer, banners and similar articles.

The quill is first attached to a strap of soft leather, later fluffy feathers may be added for decoration, also the quills of the fluffy feathers may be covered with colored yarn or leather. Sketch A shows a quill and strap with the thread secured to the quill. Sketch B shows the quill strap in position with the loop or stirrup formed below the end of the quill. The thread is again anchored to the quill tip by sewing through the quill be-

FEATHER WORK

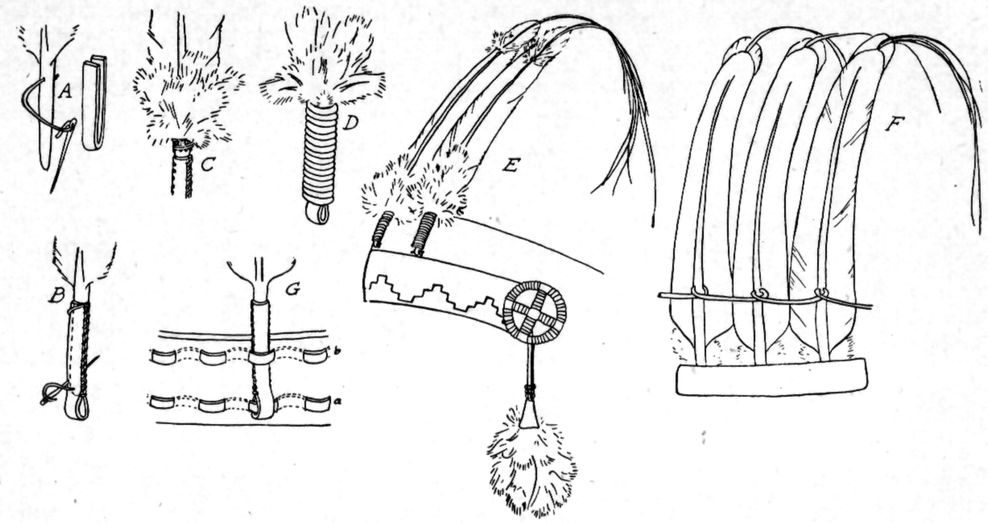


Fig. 1

fore sewing the other edge of the strap. The leather is stretched tightly over the quill before stitching in place.

In case fluffy feathers are to be attached they are secured to the quill of the larger feather as shown in sketch C. If a covering of colored yarn or leather thong is placed over the quill strap and the ends of the fluffy feathers this will then appear as shown in sketch D. Sketch E shows the method of mounting the feathers with the quills wrapped and fluffy bedecked on a head dress. The point of attachment is just above the beaded head band. The feather is now attached by a hinge fastening made by passing a thong or cord through the loop strap of the feather. The feather is free to move and is hobbled to the adjacent feathers by a leather thong or cord which passes through the quill on the under or back side as shown in sketch F.

In mounting one or more feathers to a strap head band, the detail shown in sketch G, Fig. 1, may be used. This differs from the method of mounting feathers described in the foregoing paragraph since the hobble thong passes through the head band and around the quill of the feather as indicated.

To the tip of the mounted feather may be attached a wisp of horsehair: a drop of sealing wax or cement will hold the hair in place and this may be concealed by pressing some flufly feathers into the adhesive while still soft. This hinged fastening permits the feathers and the waving wisp of horsehair to move in unison to the rhythm of the dancers' movements, thus giving bird like grace and animated charm to the moving spirit in the interpretation of his deeds and ambitions.

In equal importance to the moving feathers is the pendant tassels of fluffy feathers or horsehair, dangling from arm bands and the handles of rattles and headache sticks.

The construction detail for making fluffy pendants is shown in sketches in Fig. 2. The fluffy feather quills are perforated by the needle and first strung on the thread, sketch B, then attached to the end of a thong, (buckskin) sketches A and C. The quills are concealed by crimping a

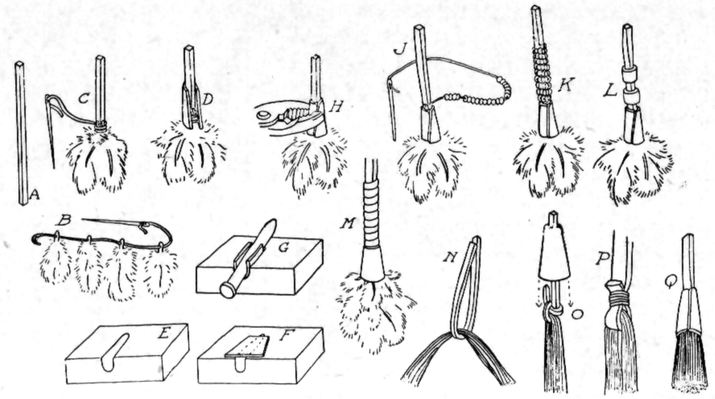
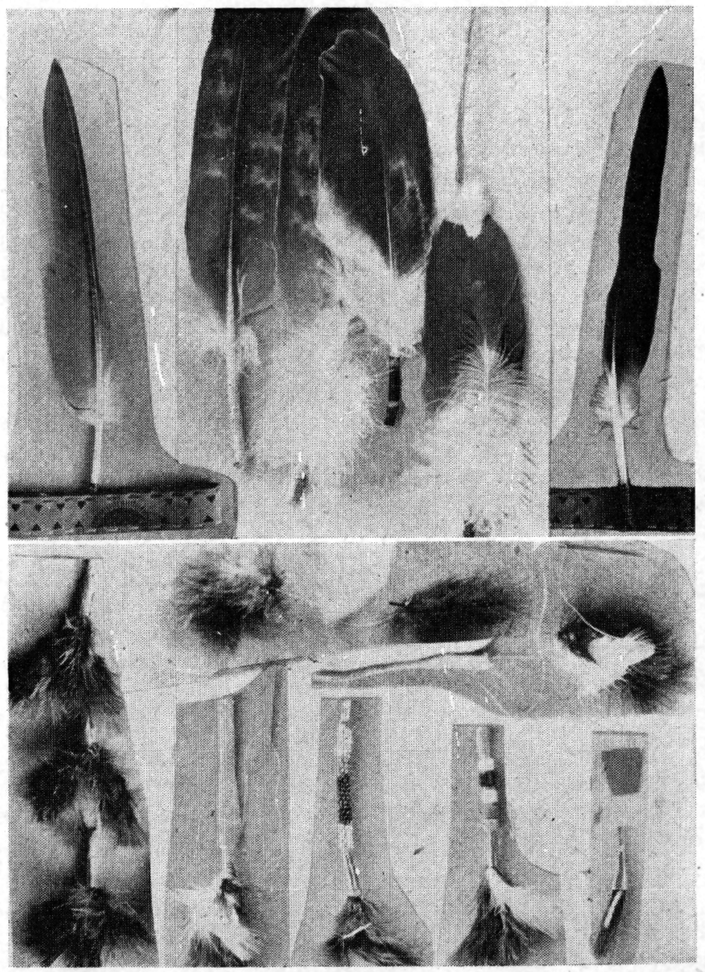


Fig. 2

piece of tin can around the thong as shown in sketch D. The wedge shaped piece of tin may be bent in the fingers and crimped in place with a pair of pliers, sketch H.



In case a number of pendants are made up at once, time will be saved and more uniform appearing tassels result if the tin covering, sketch F, is shaped in a slot filed in a board similar to the one shown in sketch E. The piece of tin is pressed into the slot with a round stick or a nail, see sketch G. After bending, the U shaped piece is pressed around the thong in the position shown by sketch D, and crimped tight around the thong and feathers as in sketch H. Sketches J and K show the method of wrapping the thong with a strand of beads. Sketch L shows the thong passing through tube beads. Sketch M shows the thong wrapped with porcupine quills.

The construction detail of a horsehair pendant is shown in sketches N, O, P, and Q. The end of the buckskin thong is looped around a small bundle of hair and either seized with thread as shown in sketch P or a simple overhand knot tied around the standing part as shown in sketch O. The piece of tin is pressed around the buckskin thong, slipped down until it covers the thong and horsehair, and crimped in this position. See sketch Q

War Bonnet and Dance Bustle

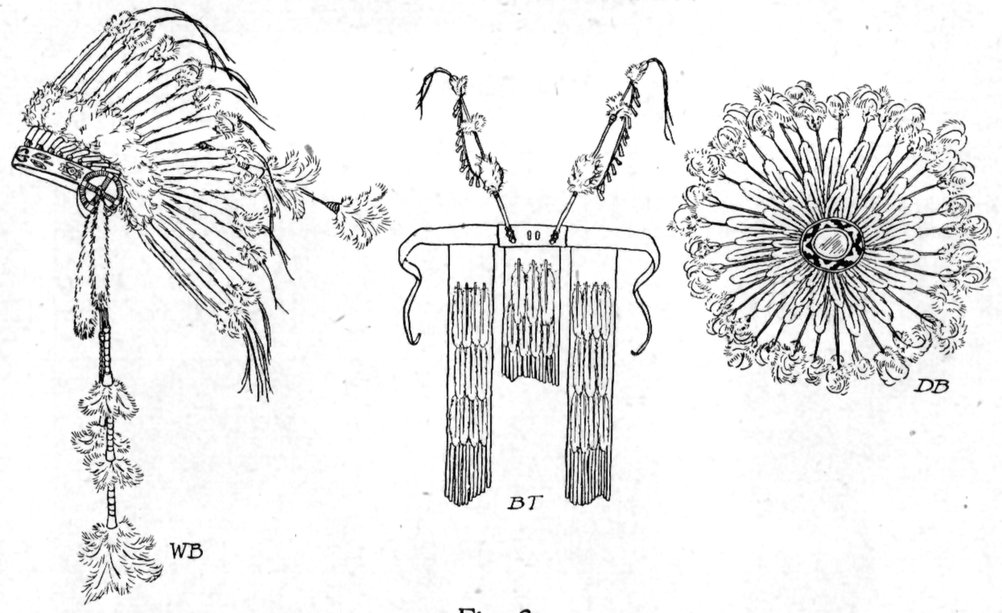
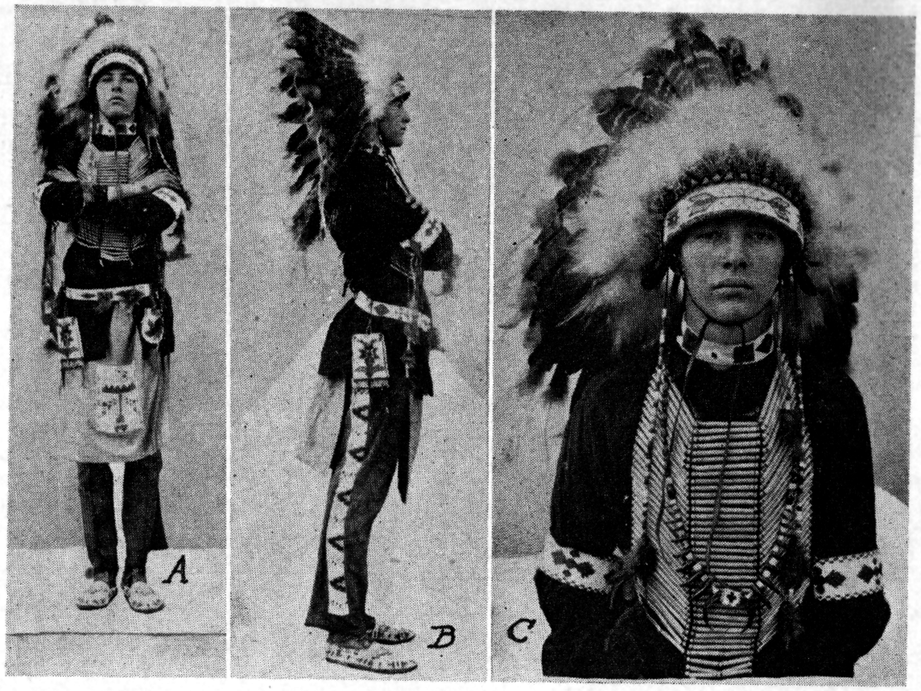


Fig. 3

The War Bonnet shown in Fig. 3, Sketch W-B, is assembled according to the method outlined in the foregoing paragraphs. The beadwork is mounted on a buckskin browband as detailed on page 464. The feathers, bead strip, and quill rosettes are mounted on the crown of an old felt hat.

Sketches BT and DB show the feathered trails and disc used in the assembly of a Dance Bustle.



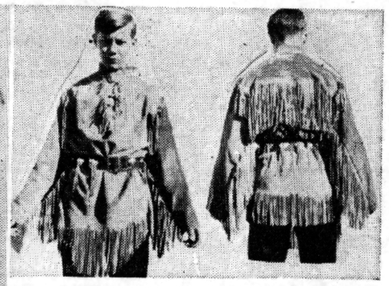
War Bonnet

Dance Bustle

INDIAN COSTUMES

The ideal leather for costumes, and that originally used, is buckskin. But due to scarcity, even among the Indians today, other materials are substituted for the genuine article. Cloth has been extensively used. Many collections of Indian clothing contain garments made from the Navy Blue Army cloth, the material used prior to the adoption of the olive drab and khaki for the soldier's uniform. The pair of leggings shown in the photograph, decorated with beaded strips and fringes around the bottom, are typical of the cloth style legging. Light weight canvas and denim are other materials used.

The suede or velvet finished split cowhides are well adapted for use in costume making, and greatly resemble buckskin in appearance. These splits may be cleaned by spreading out smooth on a table and scrubbing carefully with a back and forth movement, using a medium stiff brush and any good soap flakes dissolved to make a thick suds, in warm (not hot) water. Rinse thoroughly by sousing several times in clear water, and hang up to drain and dry. Do not wring. Any stiffness may be easily rubbed out between the fingers or with a brush.



INDIAN COSTUMES

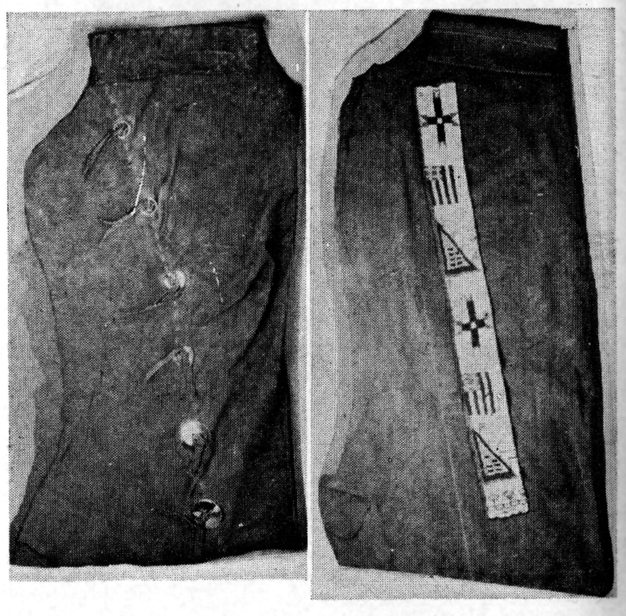
Dance Leggings

May be decorated with Conchas, Bead strips, or painted with designs to resemble Bead strips.

The leggings may be used with breech cloth and belt, only, and with headdress, necklace, or breastplate and arm bands is sufficient costume for many ceremonial dances. Bright colored shirts (dyed) may be worn with the leggings, or the pioneer shirt shown on page 481.

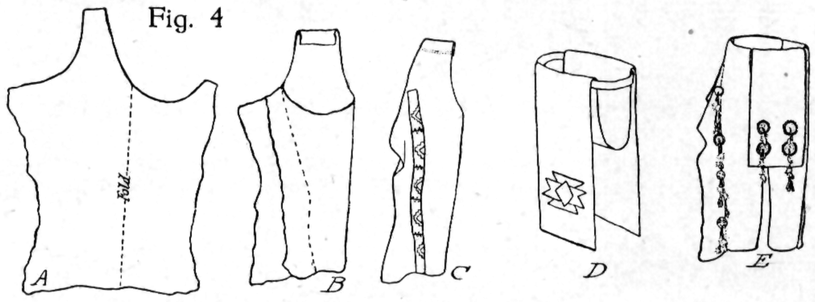
The girl's dress shown is simply three pieces of the split, draped from the shoulders where they are held together with thong strips and conchas. The pieces are joined with thong strips placed across from the under arm down.

Another style of squaw dress may be made from three large sized skins or pieces of split. This consists of one yoke piece which also forms the sleeves and two skins for front and back. These skins are either sewed together or caught with a lacing thong. A typically Indian dress would be elaborately ornamented with beads across the front and down the arms. A painted decoration in bead designs would resemble full beaded costume.



Sketches A, B, C indicate the method of making dance leggings. Sketch A shows the shape of pattern and indicates the position of the fold. Sketch B shows the legging folded over along the top edge to form a belt loop, also ready to be stitched along the dotted line. Sketch C shows a loom work bead strip attached.

Fig. 4



INDIAN COSTUMES

The Breech Clout

Sketches D and E, Fig. 4, show breech clout details. Sketch D shows how it is worn. Sketch E indicates the appearance of the breech clout when worn with a pair of leggings. Cloth or leather strips 12"x72" or 84" will make a clout long enough to carry decorations on each end. Lightweight sateen in bright colors used double in two different colors per clout are effective. Army cloth and felt used singly with edges bound in different color are prized by the Indians today.

A Method of Designing the Pattern for the One Piece Moccasin

The foot outline as indicated in Fig. 1, and the measurements shown in Fig. 2 are required.

Mark on the foot outline Fig. 3, the lines 1-3 and 6-8 to correspond with the girth measurements.

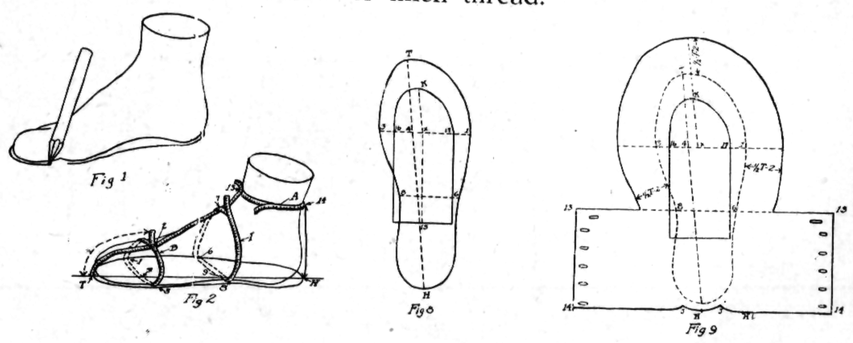
The Moccasin Tongue Dimensions are obtained as follows:

The Tongue width 16-17, Fig. 8, is 2/3 the dimension 1-3. The tip length X-K is ½ of the measurement T-2, Fig. 2. Note that line X-K parallels the line T-H. The tongue dimension X-13, Fig. 8, is the same as the measurement 2-7-13, Fig. 2.

The Moccasin Pattern is constructed as shown in Fig. 9. Place the foot outline on a piece of paper as shown by the dotted line. Extend the lines through points 1-3 and 6-8, as indicated by the dotted lines. Mark the toe portion of the pattern outline around the foot outline at a distance equal to ½ the measurement T-2 of Fig. 2. This outline parallels the foot outline from point 8 around thru points 3-T-1 to point 6.

Mark the heel line J-H-J around and parallel to the heel of the foot outline about ¼ distant. The points J-J should be about 2/3 of the heel width. From point J as a center, and a radius equal to J-H mark point H-1. Draw the line 14-H1 thru the point H1 parallel to the line 8-6, and at a distance from point H1 equal to the measurement H14, Fig. 2. Punch 6 holes in the edges 13-14 to receive the ankle thong.

The moccasin is assembled inside out, later it is reversed. The moccasin may be assembled with sinew or linen thread.



Sioux Type Moccasin

Take a piece of paper approximately 12x24 inches in size, see Fig. 4, and about 8 inches from the left hand edge draw a vertical line 8 inches long from a point about 1 inch from the top of the paper. On this line lay off the measurements T-2 and 2-7, Fig. 2. Through points 2 and 7 draw lines DE and FG parallel to each other across the paper.

About 1 inch from the right hand edge of the paper, place the foot outline pattern. See that the lines 1-3 and 6-8 coincide with lines D-E and F-G. Lay off the girth measurement B, length around the ball of the foot, on the line D-E or distance 1-11, starting at point 1.

Similarly on the line F-G lay off the girth measurement I (length around the instep) or distance 6-12 starting at point 6.

A Method of Designing the Upper for the Sioux Type Moccasin

Mark on the outline of the foot, lines 1-3 and 6-8, Fig. 3, which represents the widths of the sole at the ball and instep respectively. Fold the paper pattern of the foot outline and crease the middle point (x) of line 1-3. Fold and crease again to obtain the middle point (y) of line 6-8.

Draw a line H-T from the center of the heel to the toe as shown in Fig. 3. The greatest length from heel to toe as shown in Fig. 3 is wanted. It will be noted that this line does not pass thru points x and y, the center of lines 1-3 and 6-8, but is to be found nearer the inside of the foot outline. Proceed to lay out the pattern of the moccasin upper from the foot outline and the foot measurements indicated in Fig. 2.

Fig 1

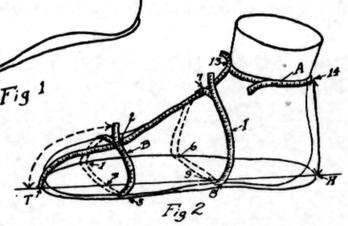


Fig 2

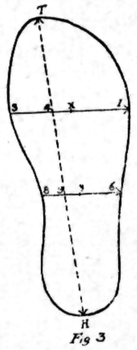


Fig 3

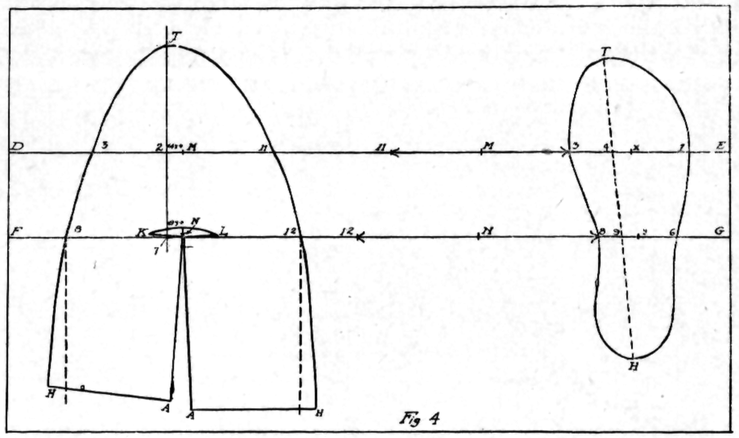


Fig 4

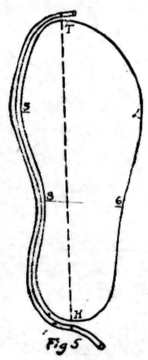


Fig 5

Fig 6

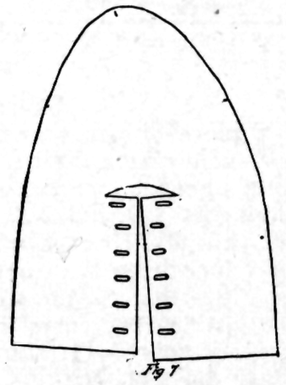


Fig 7

Sioux Type Moccasin

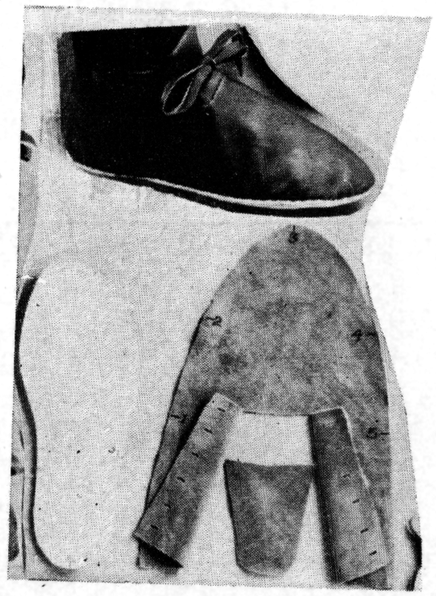
Find the middle points, M and N of lines 11-3 and 12-8. At point 2 of the upper pattern, lay off distance 4-x taken from foot outline, Fig. 4, to the right of line T-7. Also at point 7 lay off distance 9-Y to the right of line T-7. This locates position of points M and N, the centers of lines 11-3 and 12-8. Form the outline of the upper pattern by connecting points 12-11, T-3-8. This gives the size and shape of the toe portion of the upper pattern.

The length of the upper pattern is obtained by measurement of the foot outline. Use a thong or strap and obtain the length of the line from T to H, passing thru points 3 and 8 as indicated in Fig. 5. Lay off the measurement on the upper as shown in Fig. 6. This determines point H on the inside edge of the upper pattern. The length of the outside edge is obtained similarly by measuring the length of the foot outline thru points T-H and adding ¼ inch for overlap at seam.

The points H, Fig. 4 (inside and outside) extend beyond points 8 and 12 about ¾ of an inch. This will vary from about ⅝ to 1¼ inch, depending on the size of the moccasin. The line H-A is erected at right angles to the edges H-12 and H-8 and the length is equal to the height of the moccasin measurement H-14, Fig. 2.

Connect the points A with the point N, the middle point of line 8-12.

Mark the distance K-L approximately 2 inches long. This length will vary from 1¾ to 2½ inches, depending on the size of the moccasin. Cut out the segment K-N-L, which will be about ¼ to ⅜ inch wide at the middle portion.



Sioux Type Moccasin

A Method of Attaching the Rawhide Sole to the Upper with Sinew

Place the moccasin upper right side uppermost on the table. Place the sole on the upper with the flesh side uppermost. See sketch A, Fig. 10. The points of the upper and sole must come together as marked. The edge of the upper is folded over the heel as shown in sketch B and the first awl hole is also indicated. Sketch C shows the sinew inserted, and the end to be secured left long enough to be seized by at least four or five stitches. Sketch D shows the relative spacing of the holes in the sole and the position of the upper while sewing. No needle is required since the stiffened end of the dry sinew thread is readily passed thru the awl holes. The rawhide sole must be moist and pliable and the sinew should be moistened occasionally with wet fingers for an inch or two near the stitches.

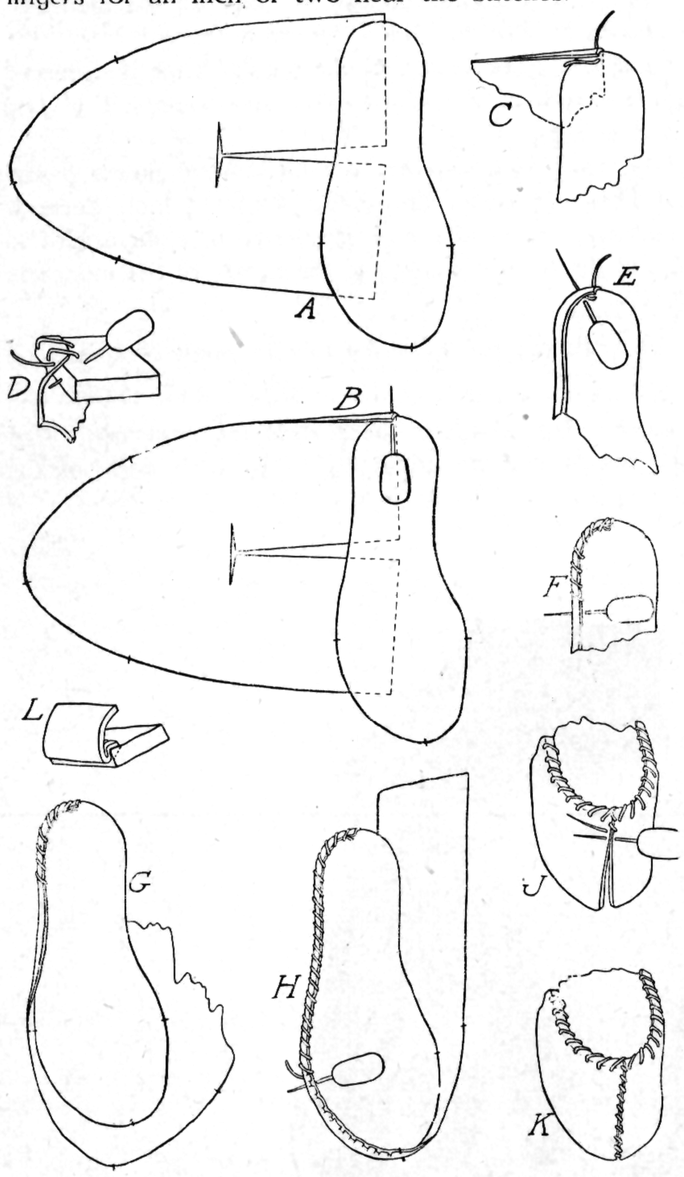


Fig. 10

Fold the upper over the edge of the sole as shown in sketch E, and continue to whip stitch the edge as shown in sketch F. This procedure is continued as shown in sketches G and H. The marked points on the upper must coincide with the marked points on the sole. Between the ball of the foot and toe a slight fullness is taken care of by fulling in between the stitches as indicated in sketch H. The lacing is continued around to the heel. The back seam is sewed together as shown in sketches J and K. If the moccasin sole has become too dry to bend easily, it should be soaked in water until pliable and the moccasin reversed. The appearance of the seam will be as shown in sketch L.

THE NAVAJO TYPE MOCCASIN

The type of moccasin here described is of the type generally found in use among the Pueblo and Navajo Indians of the Southwest. The style is peculiarly well adapted to the needs of these people. The upturned sole gives excellent protection to the foot of the wearer in a rough and stony country where the cactus abounds.

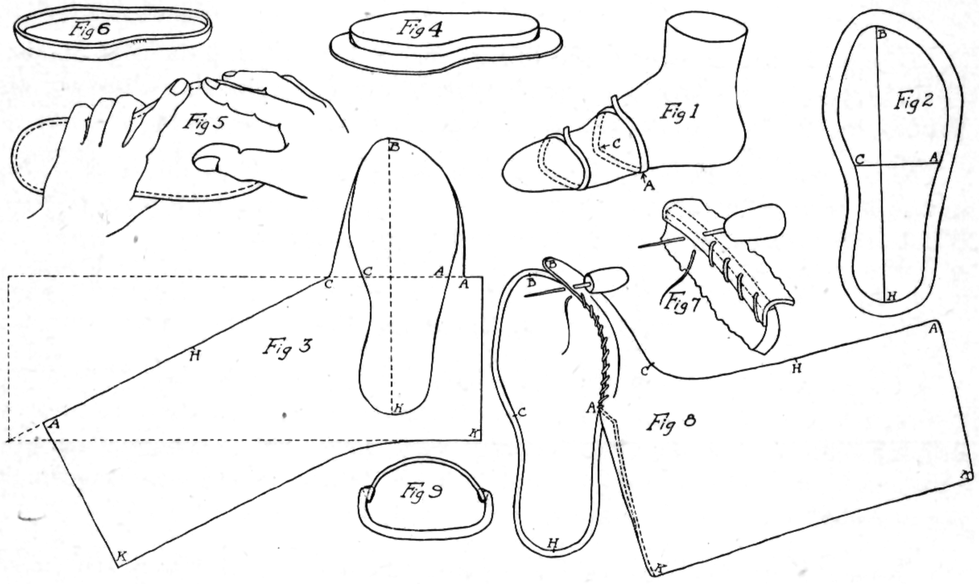
Design of Pattern

The moccasin pattern is designed from the foot outline, Fig. 2, the girth measurement of the foot at ball, Fig. 1, and instep.

The sole is made a full half inch larger than the foot outline as shown in sketch 2. After it is soaked until thoroughly wet and pliable, it is shaped over a piece of wood cut to the size of the foot outline. The edge is folded up over the board, and the sole is allowed to dry partially. The shaped sole is shown in the photograph and also in Fig. 6.

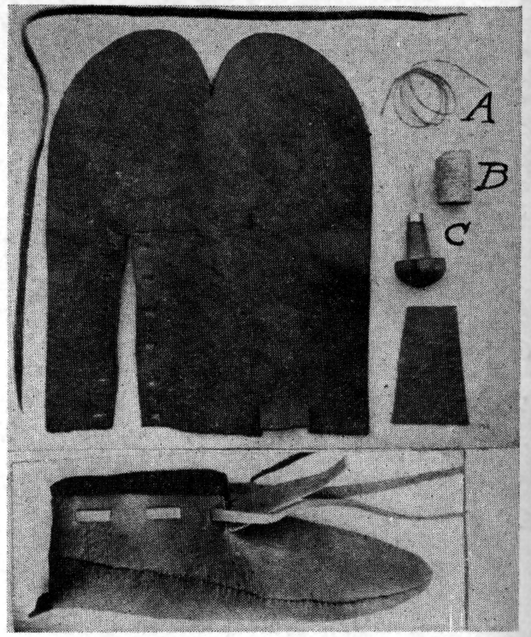
The upper pattern is made as indicated in the sketch, Fig. 3. The distance between the points C and A of the upper is the girth measurement less the width of sole including the upturned edge. The height of the upper AK is about an inch more than the length BH, Fig. 3. Mark out the rectangle bounded by the dotted line. The length of the line C-H-A is the measured length of the sole from C around the heel H to the point A.

The length is laid off on the diagonal line from C to the corner of the rectangle. Line AK is erected perpendicular to the diagonal and the line KK is made parallel to the line A-H-C and CA.



Method of Assembly

The upper is stitched to the sole with sinew as shown in Fig. 8. Start at point A, let the upper overlap the edge of the sole as shown in Fig. 7. Make the hole thru the edge of the upper and the edge of the sole with an awl and stitch from point A to B, and around the sole, bringing point C and H together, and continue on to point A. This moccasin is not assembled inside out, as is the case with the one and two piece moccasins. The upper is fastened together and held in place by a thong and concha button as shown in the photograph, page 488.



The moccasin shown in the illustration above is the style used in the Northwest by the Blackfoot and Flathead Indians. Like the Ojibway or Woods Indian type it is a soft soled Moccasin cut in one piece.

The assembly is made by sewing from toe to heel and up the back. The tongue is sewn in place. Sketch A shows a needle and waxed thread. Sketch B a leather thimble of the tube type and C is a sinew awl.

Make-Up for Head and Face

The American Indian used paint both for decoration and protection. Peace time decorations on face and body served to identify the members of organizations, also to denote achievement and rank, and to represent certain characters, natural and supernatural in ceremonials. War time decorations were considered good medicine.

In the absence of protecting clothing, the coating of the naked body with grease (rendered buffalo fat) served to protect the skin from chapping winds, blistering sunshine, also insect bites. Pigments in powder form made from minerals and vegetables were dusted over the grease covered body to give the desired effect.

Fig. 14, page 489, indicates some of the facial decorations which were used in the buffalo and ghost dances by the plains Indians. These may serve as a guide in making up. The letters used indicate colors.

All portions of the head not covered by the wig or headdress are covered with a coat of cold cream. This rubbed well into the pores of the skin, holds the powder as applied and may be removed with a cloth or cold cream remover.

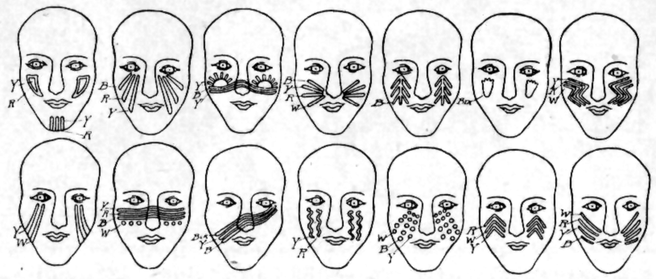


Fig. 14

The Powder is Applied to the greased skin with a powder puff or a cotton swab. The Indian redskin ground color is used, and worked well into the cold cream. Any excess is removed with cloth or cotton.

The Lining Colors for the facial decorations shown in Figure 14, are next put on. The colors are supplied in tubes, also in stick form and in small metal cans. The tubes may be used like a large pencil to mark the colors on the skin. Fine lines are made by coating a match stick, or other small stick (manicure orange wood sticks are excellent) and rubbing them on the skin.

Make-Up for Body and Limbs requires the application of the red ground color in a paste form. About a tablespoonful is mixed with a little water and stirred to a smooth consistency. A cup of water is then added to the paste and well mixed. Apply this with a cloth, rubbing on lightly and evenly to avoid making a streak. The color may be controlled by adding more powder or diluting the wash to produce the desired shade.

The Make-Up is Removed with a soft cloth, swabs of cotton or Kleenex. Additional cold cream is first applied and then rubbed off with the colored make-up and ground color which is absorbed by the cream. Repeat the process as may be necessary. Hot water and soap will remove the ground color from the body.

Sleigh Bell Bands

The sleigh bell bands, Sketch A, Fig. 15, are worn by dancers in some of the ceremonials. They may be worn like a garter below the knee or as as an anklet. Usually bells of two different tones are used and are attached to a strap, Sketch A, which may be tied, snapped or buckled together.

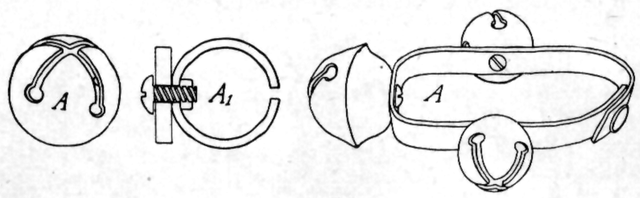


Fig. 15

Indian Lore

American history began when Columbus contacted the native Americans. It is little wonder that he fastened the name of "Indians" upon these copper colored folks since their color resembled the dark skinned inhabitants of oriental India which was the quest of his voyage. Among Europeans who wish to avoid confusion with the natives of India, reference is made to the native American as the "Red Indian of America."

Much of our history treats of the contacts with these natives. Originally, and it must be confessed with regret, our concern was elimination or control of the Indian, but now his contribution to the nation is fortunately being recognized and a definitely constructive Federal program is under way which will accord to the 300,000 native Americans remaining in our country the educational privileges and recognition so long denied them.

Several organizations and many individual and professional volunteer leaders who have been inspired by the reaction of youth to the Indian Lore Program, have brought together valuable information from scattered sources. Much of the manual skill and dramatic art of the Indian has been preserved. This has been made available to the youth of the world through the International Boys' Organizations. The appeal is not alone to the youth of America but world wide, as evidenced by the presentation of authentic Indian dances by French Boy Scouts at the last International Jamboree, four years after Indian dancing was introduced in Europe at the previous Jamboree. Recently a group of Hawaiian Boy Scouts presented American Indian dancing to Scouts in Japan where it was enthusiastically received.

It is the author's hope that the material here presented, although fragmentary, will be helpful to those giving leadership to youth, and will serve to inspire further research in Indian affairs by those persons who have or can gain the confidence of the Indian.

A great debt of gratitude is hereby acknowledged for the inspiration given by the author's friends and co-workers—Ernest Thompson Seton, Julian Harris Salomon, Williams Tomkins, Ralph Hubbard, Lloyd Shaw, Berton I. Staples, Pedro Lemos, Ray O. Lyon and others who are striving to interpret the Redman and his accomplishments.

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The American Indian, published quarterly by the American Association on Indian Affairs, Inc., a non-profit corporation, 381 Fourth Avenue, New York 16, N. Y. This Association publishes and interprets a wide variety of information and news pertaining to the rights and interests of the descendants of the "first American." Its purpose is to safeguard the liberties and promote the democratic progress of the Indians, to help them to help themselves onward in their gradual integration into American life. Subscription to the publication is by membership in the Association.

The Indian Leaflet Series, prepared from the original scientific sources by Mr. F. H. Douglas, Curator of Indian Art, Denver Art Museum, 1300 Logan Street, Denver, Colorado. These give accurate and concise information covering all the main activities and interests of all the principal tribes in America north of Mexico. They include data on the names, population, dwellings, clothing, food supply and the most important arts and crafts in each culture area. A collection of plates which form an Indian Design series is also available from the Denver Art Museum.

The Indian danced for joy and thanksgiving, also to win favor and approbation of the Great Spirit. Nowhere is there more rhythmical. dramatic and interpretative action to be found than in the old time dances of the plains Indians. Some of these dances were informal social affairs of a peaceful people. War dances were given to arouse hatred for the enemy before going on the war path. The ceremonials of the medicine men were used in the native treatment of illness and many dances corresponded to the planting and harvest festivals of other primitive peoples. The duration of these dances ranged from a few hours to several days.

The dance became a sacred thing, a form of worship, a means for the expression of ambitions, hopes and fears, also to show prowess, cunning, strategy and skill and to portray a record of achievement. It was a highly educational form of entertainment for both the onlookers and the dancers. The audience was alert and observing every motion of the dancers lest they lose the trend of thought portrayed. The dance contributed to the development of a splendid physique and quickened the aspiration for achievement. To the stimuli of the rhythm and the dramatic interpretation was added the aesthetic satisfaction of the colorful costume of quill, bead-work, feathers and paint.

The technique of Indian dancing is a difficult subject to present on the printed page. Like other arts skill may only be transferred by competent instructors and acquired after considerable practice. The Indian youth learned to dance when as a papoose he peered over the edge of the back pack cradle and caught the rhythm of the tom-tom. Long before he could walk or stand alone, his mother would support him by the arm pits and with a bouncing motion tap his feet upon the ground to the beat of the tom-tom. From such beginnings the love of rhythm and interpretative expression was instilled into the soul of the Indian from infancy.

If it were possible to learn the dances in their entirety it would not be feasible to use them, though time permitted, because of the physique and endurance required. It is quite in keeping, however, to use excerpts from dances which may be applied to pageantry for action or background material. A varied program may be built around some historical event or in the dramatization of song, myth or legend.

It may be of interest to organizations featuring an Indian Lore Program to review the details of a pageant based on an Indian legend which was presented by Boy Scout troop No. 10. The dances used are illustrated pictorially and described on pages 500 to 508.

Over a period of ten years Troop 10, organized by the author, specialized in handicraft and Indian Lore, as an older boy activity. They constructed their own costumes and became proficient in Indian dancing. They provided programs on many occasions, and thru income from these sources acquired troop properties and equipment. An outgrowth of the interest in the Colorado Springs Troop 10 Indian Lore Program has been the development of the nationally known pageantry of the Koshare Club of La Junta, Colorado, by the original assistant scoutmaster J. F. (Buck) Burshears.

THE ORIGIN OF THE MANITOU SPRINGS ACCORDING TO THE INDIAN LEGEND

A Pageant of Pantomime, Indian Dance, Song and Sign
Directed by Lester Griswold, Scoutmaster, 1924-1935

Presented by Community Troop No. 10 of the Pikes Peak Area Council

Historical Notes

"Ruxton, the English traveler and historian, who visited the Pikes Peak Region in 1847, described this section as a veritable hunter's paradise. On account of the great quantity of game in this region, bitter contests for possession were annual occurrences among the Indian tribesmen of mountain and plain for ages before the white man came. Each year large parties of plains tribes came into the region, made their usual offerings at the 'Boiling Springs' and continued on up Ute Pass into the mountains. These Indians believed that the 'Great Spirit' dwelt in this spring, that the bubbles coming up through the water were the result of his breathing and that it was necessary for them to make offerings to him in order to be successful in warfare and in the pursuit of game." Taken from "Memories of a Lifetime in the Pikes Peak Region," by Irving Howbert.

THE LEGEND

It happened that two hunters of different nations met one day on a small rivulet where both had repaired to quench their thirst. A little stream of water, rising from a spring on a rock within a few feet of the bank, trickled over it and fell splashing into the river. To this the hunters repaired; and while one sought the spring itself when the water, cold and clear, reflected on its surface, the image of the surrounding scenery, the other, tired by his exertions in the chase, threw himself at once to the ground and plunged his face into the running stream.

The latter had been unsuccessful in the chase, and perhaps his bad fortune and the sight of the fat deer, which the other hunter threw from his back before he drank at the crystal spring, caused a feeling of jealousy and ill-humor to take possession of his mind. The other on the contrary, before he satisfied his thirst, raised in the hollow of his hand a portion of the water, and lifting it toward the sun, reversed his hand and allowed it to fall upon the ground— a libation to the Great Spirit who had vouchsafed him a successful hunt, and the blessing of the refreshing water with which he was about to quench his thirst.

Seeing this and being reminded that he had neglected the usual offering only increased the feeling of annoyance, which the unsuccessful hunter permitted to get the mastery of his heart; and the Evil Spirit at that moment entering his body, his temper fairly flew away, and he sought some pretense by which to provoke a quarrel with the stranger Indian at the spring.

Comanche—"Why does a stranger," he asked, rising from the stream at the same time, "drink at the spring-head, when one to whom the fountain belongs contents himself with the water that runs from it?"

Sign—(Question—you drink—above me—spring possession—me).

Shoshone—"The Great Spirit places the cool water at the spring," answered the other hunter, "that his children may drink it pure and undefiled. The running water is for the beasts which scour the plains. Au-Sa-Qua is a chief of the Shoshone; he drinks at the headwater."

Sign—(Great Mystery fire—spring—all people—all buffalo, bear, horse —drink river—Me—Chief Shoshones—me drink spring).

Com.—"The Shoshone is but a tribe of the Comanche," returned the other, "Waco-mish leads the grand nation. Why does a Shoshone dare to drink above him."

Sign—(Shoshone—you all people Comanche — question — you drink above me).

Sho.—"He has said it. The Shoshone drinks at the spring-head; other nations of the stream which runs into the field. Au-Sa-Qua is chief of his nation. The Comanche are brothers. Let them both drink of the same water."

Sign—(You talk—me Shoshone—drink spring—you all people drink river—me chief—possession people—Comanche brothers—to drink equal spring).

Com.—"The Shoshone pays tribute to the Comanche. Waco-Mish leads that nation to war. Waco-Mish is chief of the Shoshone as he is of his own people."

Sign—(You money me—me chief—lead people war—me chief you all people—me all people).

Sho.—"Waco-Mish lies; his tongue is forked like the ratlesnake; his heart is black as the Misho-Tunga (bad spirit). When the Manitou made his children, whether Shoshone or Comanche, Arapahoe, Shian, or Pa-ne, he gave them buffalo to eat, and pure water of the fountain to quench their thirst. He said not to one, drink here, and to another drink there, but gave the crystal spring to all that all might drink."

Sign—(You Comanche lie—rattlesnake—heart black—Medicine great —make all people Shoshone—Indian sheep eat, Comanche—Indian snake, Arapahoe—Indian mother, Cheyenne—Indian finger choppers, Pawnee—Indian wolf—give all buffalo eat— spring water drink.—No talk one drink [here, sit]—one people drink [there, sit] part—Great Mystery gave spring all people drink).

Waco-Mish almost burst with rage as the other spoke; but his coward heart alone prevented him from provoking an encounter with the calm Shoshone. Au-Sa-Qua, made thirsty by the words he had spoken—for the Redman is ever sparing of his tongue—again stooped down to the spring to quench his thirst, when the subtle warrior of the Comanche suddenly threw himself upon the kneeling hunter, and forcing his head into the bubbling water, held him with all his strength, until his victim on longer struggled, his stiffened limbs relaxed, and he fell forward over the spring, drowned and dead.

Over the body stood the murderer, and no sooner was the deed of blood consummated than bitter remorse took possession of his mind, where before reigned the fiercest passion and vindictive hate. With hands clasped to his forehead he stood transfixed with horror, intently gazing on his victim, whose head still remained immersed in the fountain. Mechanically he dragged the dead Indian from the water, which, as soon as the head of the dead Indian was withdrawn, the Comanche saw suddenly and strangely disturbed. Bubbles sprang up from the bottom, and rising to the surface, escaped in hissing gas. A thin vapory cloud arose, and gradually dissolving displayed to the eyes of the trembling murderer, the figure of an aged Indian, whose long snowy hair and venerable beard blown aside by the gentle air from his breast, discovered the well-known totem of the great Wa-Kan-Aga, the father of the Comanche and Shoshone nation, whom the tradition of the tribe, handed down by skillful hieroglyphics, almost deified for the good actions and deeds of bravery, this famous warrior had performed when on earth.

Stretching out a war-club towards the frightened murderer, the figure thus addressed him:

"Accursed of thy tribe, this day has severed the link between the mightiest nations of the world, while the blood of the brave Shoshone cries

to the Manitou for vengeance; may the water of thy tribe be rank and bitter in their throats."

Thus saying, and swinging his ponderous war club around his head, he dashed out the brains of the Comanche, who fell headlong into the spring which from that day to the present moment remains rank and nauseous, so that not even when half dead with thirst, can one drink the water of the spring.

Sign—(Abuse, defy you—now day you no friend exterminate—blood Shoshone calls great Mystery arrest you—kills—Great Mystery give you people spring—bitter water drink).

The good Wau-Kan-Aga, however, to perpetuate the memory of the Shoshone warrior, who was renowned in his tribe for valor and nobleness of heart, struck with the same avenging club, a hard flat rock, which overhung the rivulet, just out of sight of this scene of blood, and forthwith the rock opened into a round, clear basin, which instantly filled with bubbling sparkling water, than which no thirsty hunter ever drank a sweeter or cooler draught.

Thus the two springs remain, an everlasting memento of the foul murder of the brave Shoshone and the stern justice of the good Wau-Kan-Aga; and from that day the two mighty tribes of the Shoshone and Comanche have remained severed and apart, although a long and bloody war followed the treacherous murder of the Shoshone Chief and many a scalp torn from the head of the Comanche paid the penalty of his death.

This legend was portrayed in pageant by Boy Scout Troop No. 10 in the 1930 Jamboree conducted by the Pikes Peak Area Council. The performance was given in the municipal auditorium and use was made of both the stage and a portion of the auditorium adjacent to the orchestra pit. A woods scene drop and wings formed the background. The stage setting and the illumination, also the music selected for the action portrayed, are described on pages 496 to 498.

The legend was adapted to a two act performance and it was possible to follow with historical accuracy most of the action outlined in the narrative. Group dancing was used only in the first act and furnished incidental background supporting the introductory scenes.

The action of the Hunter, Scout and White Spirit were pantomime, their monologue and dialogue being given in Indian Sign Language. To interpret the sign talk to the audience and preserve the illusion that the characters were deep voiced braves, adult readers stationed in the orchestra pit repeated the dialogue to accompany this action.

The stage setting remained the same throughout the pageant and transition from scene to scene was obtained through changes in the illumination values, and through the character of the music which was suited to the action.

Adaptation of the Pageant from the Indian Legend

ACTION AND SETTING

Act I—Afternoon, about Sundown
Scene I.

Two different tribes are in camp and both are peacefully enjoying the evening, unaware of the presence of the other. The Shoshones, a mountain tribe, are seated back stage around their Council Fire. The camp of the Comanches from the plains is situated in front of the stage on the auditorium floor.

Scene II.

The Comanches engage in a game of "throw the lance," singing as they play, while the Shoshones remain seated. The game becomes less vigorous and the singing stops as a scout from the Comanches visits the spring. He conforms to the Indian custom of making an offering to the Great Spirit, then returns to the group. The game stops and the players take seated positions in a circle. They begin to dance.

The Shoshones send a scout from their council to pay homage to the Great Spirit and he discovers evidence of the enemy. He returns to the council with the news of his discovery and the seated Shoshones arise and take positions in a square in readiness for the Ghost Dance.

Scene III—Tribal Dances

In preparation for the morrow's hunt both tribes seek to win favor from the gods by dancing. At the close of the dance hunters are chosen to go forth in search of game.

Curtain.

MUSIC—PANTOMIME—ILLUMINATION

ACT I.

Scene I.

Illumination—Strong light, not dazzling, both groups in equal prominence.

Scene II.

The Comanches are singing as they play the game. Eh-ya-ya—music, see page 499.

Follow Scouts with amber spotlight.

As the Comanche Scout approaches the Spring, the Spirit of Wana is sung from the pit, continuing until the second Scout arrives. Repeat if necessary but stop music and song as the enemy's offerings are discovered.

The Indian approaches the Spring using the Hunting Step. He cautiously and reverently places a necklace arm band or other beadwork nearby and drops to his right knee to dip a handful of water from the Spring. This he lifts toward the sky for an instant, extending an offering to the Great Spirit. Without lowering his hand, he reverses it and lets the water fall to the ground. Assuming the prayer posture he makes his petition to the Great Manitou. Kneels, hands upraised, head uplifted, hands lowered to breast height. Taps breast with clenched fist and bows head. Makes sign—Great Mystery make sunrise in our hearts. Sign Talk—page 499. Toe Heel step back to Camp—Music (Tom-tom) low and suppressed.

As the Comanche Scout withdraws, the Shoshone aproaches the Spring under cover and with care and reverence. His offering is placed and a petition made to the Great Manitou in the same manner as the first Scout. Suddenly he discovers the offering left by the Comanche. He dances back to the Council ring, using the Hunting Step and solo postures for tracking the enemy. Music—Tom-tom, low and suppressed.

Scene III.—Tribal Dances.

Music—Tom-tom. Lights—full brilliance.

Comanches on the floor present: 1—Sage Chicken Hop. 2—Sioux Circle. 3—Canoe Step, and 4—Buflalo Dance from which emerges the Chief, who choses a hunter to go in search of game. The Hunter leaves the dance circle and approaches the stage, using the Hunting Step. He remains off the stage until the beginning of Act II.

In the Shoshone group on the stage, the square Ghost Dance is moved to the left. The East and West sides approach the center and return. The square continues to move until the opposite sides have approached the center. Follow with the prayer to the four winds, and after the solo dance (using the Grape Vine step) over the prostrate bodies, end scene III with the song Shupeda.

Tom-toms become low suppressed. Lights dim gradually during dance. Shupeda may be sung by the dancer or by a soloist in the orchestra pit, while the dancer holds the upright prayer posture.

At the end of the dances all Indians go to the orchestra pit and get ready to sing the Sun Worshipers Song, and remain in pit throughout Act II.

ACTION AND SETTING

Act II—Morning

Scene I.

The faint light of dawn discloses a single Sun Worshiper at prayer, and from the distance the singing of the tribe is heard. As the sun appears the Indian sings the tribal prayer song.

Scene II.

The Hunters appear. The Shoshone on the skyline and the Comanche on the plains in search of game. Neither is aware of the other's presence.

The Shoshone looks about him, makes discovery of game and approaches cautiously to a better position for a shot. He is seen to shoot and disappear in pursuit of his quarry. He reappears carrying the deer and approaches the spring.

Scene III.

The Comanche in the meanwhile searches for game without success, and finally goes to the Spring to quench his thirst. He drinks of the water from the rivulet below the spring. The two hunters discover each other.

The Comanche seeks to provoke a quarrel. Unmoved the Shoshone again bends down to drink. The Comanche takes advantage and pounces upon his prone body. A brief struggle follows and the Comanche arises, the lifeless body of the Shoshone is left lying at his feet.

MUSIC—PANTOMIME—ILLUMINATION

Act II.—Morning, Early Dawn
Scene I.

Overhead and footlights dim on stage. Dim blue light from back stage illuminates a figure which appears in partial silhouette on the horizon, arms uplifted, facing east.

Music—Sun Worshipers song by two groups of Indians and soloist, using echo effect

Lights—Back stage lights are brightened (overhead and footlights remain dim) and gradually the color changes to red as the song is finished. Then the amber spot is thrown on the figure and he sings Wakanda or holds posture while it is sung from the pit.

The figure walks slowly backward along the skyline with arms still uplifted and at the conclusion of the song disappears behind a rock.

Scene II.

The overhead and footlights are brightened sufficiently to give low visibility to the hunters, who appear from the right.

The Comanche is dancing quietly in the foreground using: 1—Hunting Step, 2—Tracking, 3—Stalking, 4—Listening postures. The Shoshone in the background goes through similar pantomime, finally sights game and shoots. He jumps down off the runway, picks up the deer and returns to the stage from the left. Though weary and thirsty he carefully places the carcass of the deer nearby and assumes the prayer posture. Makes sign Great Mystery works good—my people hungry. Kneels before the Spring and repeats action of Scene II.

Lights—full.

Scene III.

The Comanche wearied by his unsuccessful hunt rushes in without observing the Shoshone, throws himself on the ground in great haste and drinks, omitting the ceremony offering drink to Great Spirit.

Meanwhile the Shoshone has quenched his thirst and as he arises to his knees he discovers the Comanche drinking. Quietly and calmly he rises to a standing posture, with body erect and arms folded. He observes the Comanche as he finishes drinking and waits for him to speak. The dialogue begins, the Comanche and Shoshone using sign while the spoken word comes from readers in the orchestra pit.

The angry Comanche picks up his weapons and flies into a rage, making hasty sign talk and menacing gestures. The self-controlled Shoshone stands his ground, exhibiting no fear as he answers the Comanche in sign talk, and stoops to take another drink. (Music—Weeping Waters; Lights—full.) The Comanche with vindictive hatred cowardly pounces upon the prostrate Shoshone and forces his head under the water. The Shoshone struggles in vain to free himself and falls headlong into the spring.

ACTION AND SETTING	MUSIC—PANTOMIME—ILLUMINATION
Scene IV. As the mood of the Comanche changes from triumph to remorse he drags the body from the water whereupon a vapory cloud arises. When this disappears there stands before him the Great White Spirit of Wah-kan-aga, father of both nations. Wah-kan-aga admonishes the Comanche, places a curse upon him and slays him with his club. With the thud of the falling body a rank, muddy stream of water gushes forth.	**Scene IV.** Lights gradually grow dim. The Comanche's feelings are mingled. He is at first triumphant and boastful and starts to dance. See solo dance, page 510. Obviously he is without any feeling of satisfaction and becomes hesitant as he views the body of his victim. His attitude slowly changes and bitter remorse takes possession of him. He dances about the body trying to revive the Shoshone, using the solo postures of the white spirit. When all this fails he drags the body from the water. Vapor cloud arises (see paragraph, page 499, for production of vapor), and as it disappears the figure of Wau-kan-aga is disclosed. (Music ceases—white spotlight on figure of spirit.) He extends his war club toward the frightened Comanche and appears to address him. Monologue is given by the reader in the orchestra pit. The Comanche tries to ward off the influence of Wau-kan-aga, but fails and attempts to slink away followed by the White Spirit who strikes him dead with the war club. (See properties for detail.) The Comanche gives a lusty death cry as he falls mortally wounded and writhes in convulsive agony. The lights grow dim and as the body of the Comanche strikes the ground the light in the fountain is switched on a flow of muddy water bubbles forth. (See properties for fountain construction) page 499.
Scene V. Wah-kan-aga returns to the body of the slain Shoshone and revives him. He then strikes the rock with his war club, bringing forth a bubbling Spring of sweet clear water, and returns to Shadow-land, taking the Shoshone with him.	**Scene V.** Lights all dim. Amber spot on the bitter spring and white spot on Wau-kan-aga who returns to the murdered Indian and dances. 1—White Spirit postures in reviving Shoshone, 2—Makes petition to the Great Mystery to take the Shoshone from earth. Both exit through opening in the center of the stage. Spot and foot lights out, overhead lights very dim. Curtain to conceal skyline.
Scene VI.—Sunset. An Indian singer appears on the skyline and offers thanks.	**Scene VI.** An Indian brave appears on the skyline in standing prayer position, facing west. Use back stage lighting to give silhouette of figure which posture is held during the Sunset Song. Singing by Indian or by soloist in the pit. At the conclusion of the song the curtain is lowered to the skyline for a moment to permit the Indian to leave the scene. Back stage lights out. Curtain raises and spot lights are thrown on the Springs. Dim lights overhead. Blue spot on the clear Spring and amber spot on the muddy bitter Spring. **END**

INDIAN LORE

Stage Properties

The entire stage setting was made by the Scouts of Troop 10. The troop tepee was suspended from above as the space was insufficient for the use of the poles. Its location was back stage, right side. In front of the tepee a council fire was erected for Scene 1. This was removed prior to the Ghost Dance. A skyline of wall board eight feet high, serrated and stained to resemble rock extended from the tepee to the extreme left. A two foot runway, back of the wall board skyline, and carried on sawhorses supported the Indian hunter. In front of the rocks a platform two feet high and ten feet wide extended from the center line of the stage to the extreme left and was approached from the right side by an inclined runway. All corners and edges were concealed by evergreen boughs and other native verdure. An opening in the wall board near the center of the platform concealed by a wall board rock permitted the entrance and exit of Wah-kan-aga. A slit between floor boards to the left of the rock made possible the use of a photographic flood light gun to produce a smoke cloud out of which Wah-kan-aga emerges (as he steps from behind the rock). To the flash powder a little black powder was added to increase the volume of the smoke screen. A dish pan set into the platform made the spring. A fish pond of shallow depth and about eight feet long formed the rivulet which descended from the spring. This was placed on the stage floor and protruded from the platform on the right side. Into this the water from the bubbling fountain was caught and carried away through a hose. The two fountains were made from one gallon glass bottles. The bottoms were removed and a block of wood supporting a receptacle and lamp bulb were inserted from below. The circuit contained a sign flasher which was placed in the receptacle under the lamp bulb. A glass funnel inserted in a rubber cork was placed in the top opening of the bottle. A rubber tube connected the bottom of the funnel with a water line. The city water pressure was sufficient to make the water spout through the funnel and fall back down over the bottle. The run off was caught in a pan placed under the bottle. In the glass bottle fountain which represented the muddy water an orange lamp bulb was used, and the surface of the bottle was stained with brown dye. The sparkling fountain contained a white frosted bulb.

MUSIC USED IN THE PAGEANT

Rhythmic Vocables—used during the game—Tom-Tom, **1-2-3, Loud,** Soft, Soft. Eh-ya-ya, Eh-ya-ya, Eh-ya-ya, ho-o-oh! Repeat.

The Spirit of Wana—Lieurance. Publisher, Theodore Presser Co., Phila.

Shupeda, (Omaha)—27th Am. Rep. Bur. Eth., p. 130, also p. 297, The Book of Indian Crafts and Indian Lore by Julian Harris Salomon.

The Sun Worshipers (Zuni)—Carlos Troyer. Publisher, Theodore Presser Co., Phila., p. 166. The Rhythm of the Red Man by Julia M. Buttree.

Wakanda (Omaha Tribal Prayer) 27th Am. Rep. Bur. Eth., p. 130, also p. 302, The Book of Indian Crafts and Indian Lore by Julian Harris Salomon.

By the Weeping Waters (Chippewa)—Lieurance. Publisher, Theodore Presser Co., Phila.

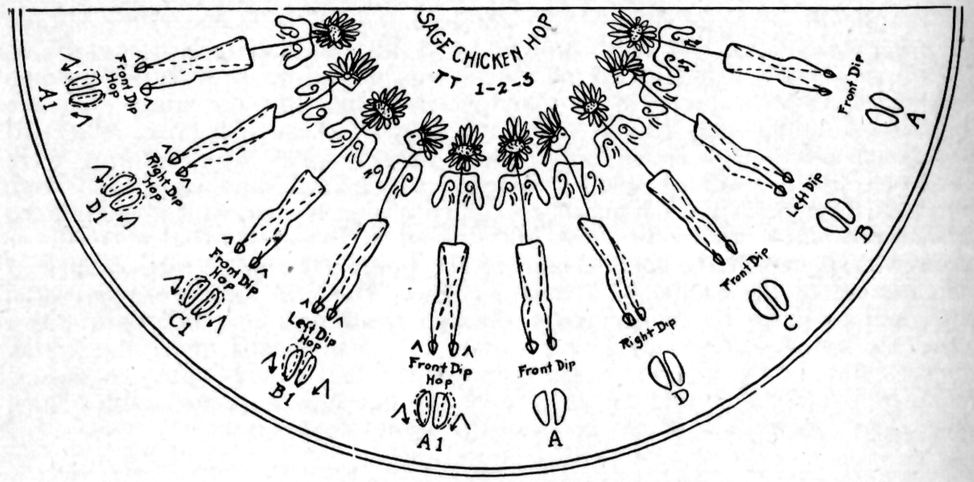
Sunset Song (Zuni)—Carlos Troyer. Publisher, Theodore Presser Co., Phila.

Universal Indian Sign Language—Wm. Tomkins, Published by author, San Diego, California.

Dance Steps

The dance steps and figures here presented are but fragments of the dances used by the plains Indians. Just where they originated is a matter of conjecture. The Indians were constantly appropriating ideas from other tribes and from nature and adapting them to their own activities. It is reasonable to believe that the Canoe Step originated in the cultural areas occupied by the woods Indians, yet it is used by the Indians of the plains and mountain areas as well. The Sage Chicken Hop Step is without doubt an adaptation of the Prairie Chicken's antics. When that costume creation, the dance bustle, is worn in this dance, the resemblance to a strutting bird with beating wings and stiff legged hop step is most realistic.

The attempt is here made to portray the elements of several dance steps by means of a pictorial chart. The foot work is indicated by tracks, body posture depicted by line sketches, and both are shown in progression. The formation of the dance is indicated for the group as well as the individual dancers. The rhythm is coordinated with the foot work, each beat and foot print being numbered to correspond.



The Sage Chicken Hop Step

The first part of this step is in reality only a rhythmical motion used as a warming up exercise prior to the dance. The tom-tom beat is a 1-2-3; 1-2-3 tempo or a loud-soft-soft, loud-soft-soft beat, accenting number one beat. The posture changes are indicated in Fig. 1. Sketch A shows the position of the dancer. The tracks indicate that the feet are together, and they remain in the same position for the four motions indicated by the Sketches B-C-D. The posture sketches show the figure facing the center of the circle. The arms are in the thrust position, fists clenched, and on the accented or loud tom-tom beat the knees are kept together and bent forward in a front dip. The body returns to the standing position indicated and the fists are moved up and down with a staccato-like accent on each beat (two-three) of the tom-tom. The rhythm is soon caught and the coordination of the body motion (knee, bend or dip) and body movement with the tempo of the tom-tom is quickly accomplished.

This cycle is repeated for postures shown in Sketches B-C-D with but one difference. The knee bend is to the left in posture B, front in posture D and again to the front as shown at A or the starting position.

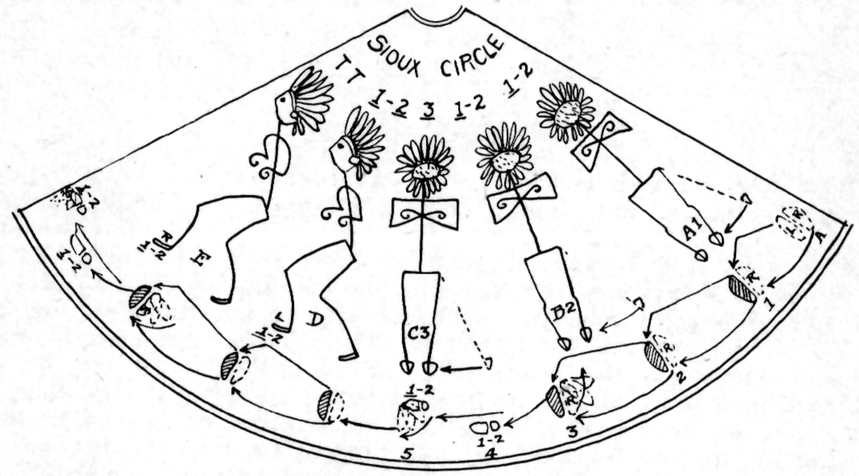
In Sketches A1 to D1, the Hop Step is indicated and the body motion outlined above is identical for each posture with the exception that a vertical

hop is made on each loud beat of the tom-tom. This precedes the knee bend. The vertical hop is indicated by the arrows on each side of the tracks and the footprints shown on the dotted line represent the motion of the feet out of the original track during the hop.

The Sioux Circle Step

Two distinct steps are used in this dance. Three side steps to a 1-2-3 steady, slow beat of the tom-tom are taken to either the right or the left. These are followed by two toe-heel steps to a 1-2; 1-2, loud-soft; loud-soft, beat of the tom-tom.

This step is started as indicated in Fig. 2, Sketch A. Both feet are together, the body is facing toward the center of the circle and the arms are folded, see posture A1. The left foot is lifted and moved one short step to the left. The right foot is drawn along the floor with a sliding motion and placed beside the left foot as indicated by the footprints at point 1. This is repeated for beats 2 and 3. The left foot should strike the floor on each beat of the tom-tom.

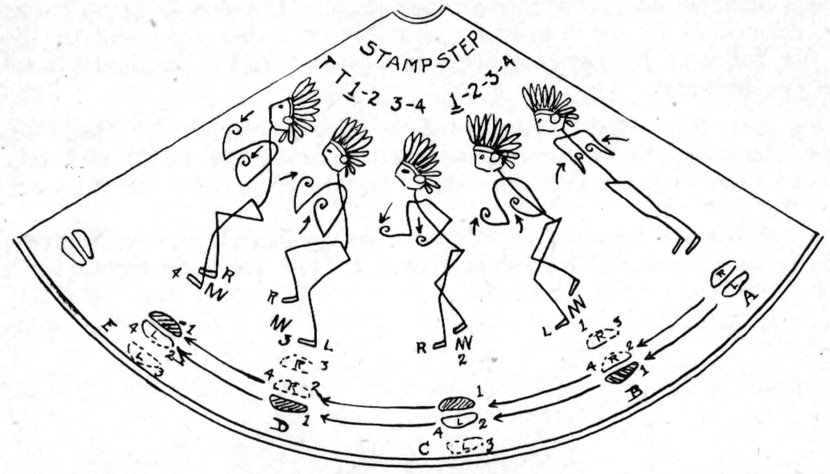


The transition from the side step to the toe-heel step is made as the body faces left. The arms are unfolded and brought to the thrust position with the fists clenched. As the body swings to the left, the weight of the body is thrown on the ball of the right foot, the heel of which swings toward the center of the circle as indicated by the arrow on the footprints, point 3. One short step is taken with the left foot, the ball of which is brought down with a stamp on the one beat of the tom-tom. The weight is transferred to the ball of the left foot and the body is bent forward in a crouched position. The left knee is dipped forward, and this lifts the heel slightly. As the knee is straightened the heel is brought in contact with the floor on the two beat of the tom-tom. This gives a graceful falling and rising motion to the body on each toe-heel step. The fist and arm motion is coordinated with the foot movements, and the clenched fists are moved downward on the one beat and upward on the two beat. The arms are moving freely and the elbows swing with a flapping motion. This gives a bouncing rhythmic value to the body motion. This step, the toe-heel or Hunting Step, as it is sometimes called, is used in many of the solo dances described later on.

After another toe-heel step is taken with the right foot, the pivot is made on the ball of the right foot (see footprints at point 5), in order to bring the body again into a position facing the center of the circle. The

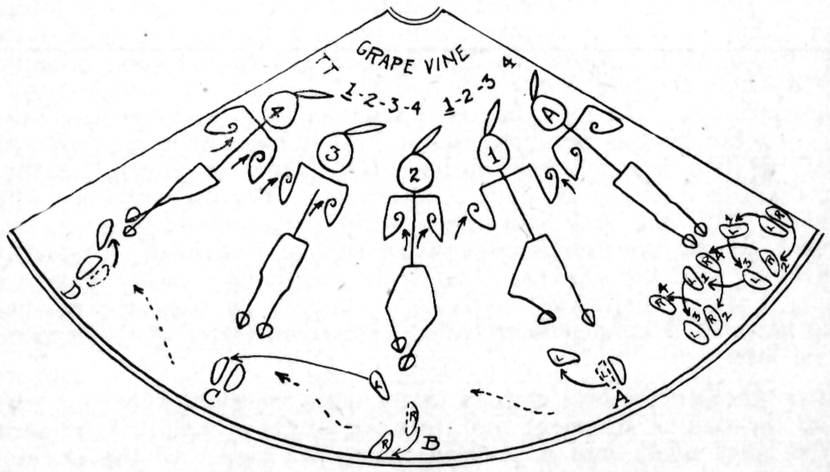
tom-tom beat changes to the 1-2-3 tempo and the left side steps are repeated. This figure constitutes a complete cycle in the Sioux Circle Dance. The dance may move a predetermined number of times to the left or right as desired.

The Stamp Step



This step is shown in Fig. 3. The tom-tom beat is a **1**-2-3-4, **1**-2-3-4, or a loud, soft, soft, soft; loud, soft, soft, soft beat. The body is facing to the left along the circumference of the circle. Fists and arms are at the thrust position. Both feet are together as shown by the foot prints in position A. One step forward is taken with the left foot on the one beat. The right foot is brought forward, placed beside the left foot (see foot-print No. 2), on the two beat, see point B. The right foot is extended to the right and stamped in the position of the footprint No. 3 on the three beat, and again back to the position of No. 2 footprint on the four beat, see point B. A step is taken along the circumference of the circle with the right foot on the one beat, the left foot tapping the floor on the two, three and four beats in the position indicated by the footprints at point C. This completes the cycle for both feet. Another complete cycle is indicated at point E.

Grape Vine Step

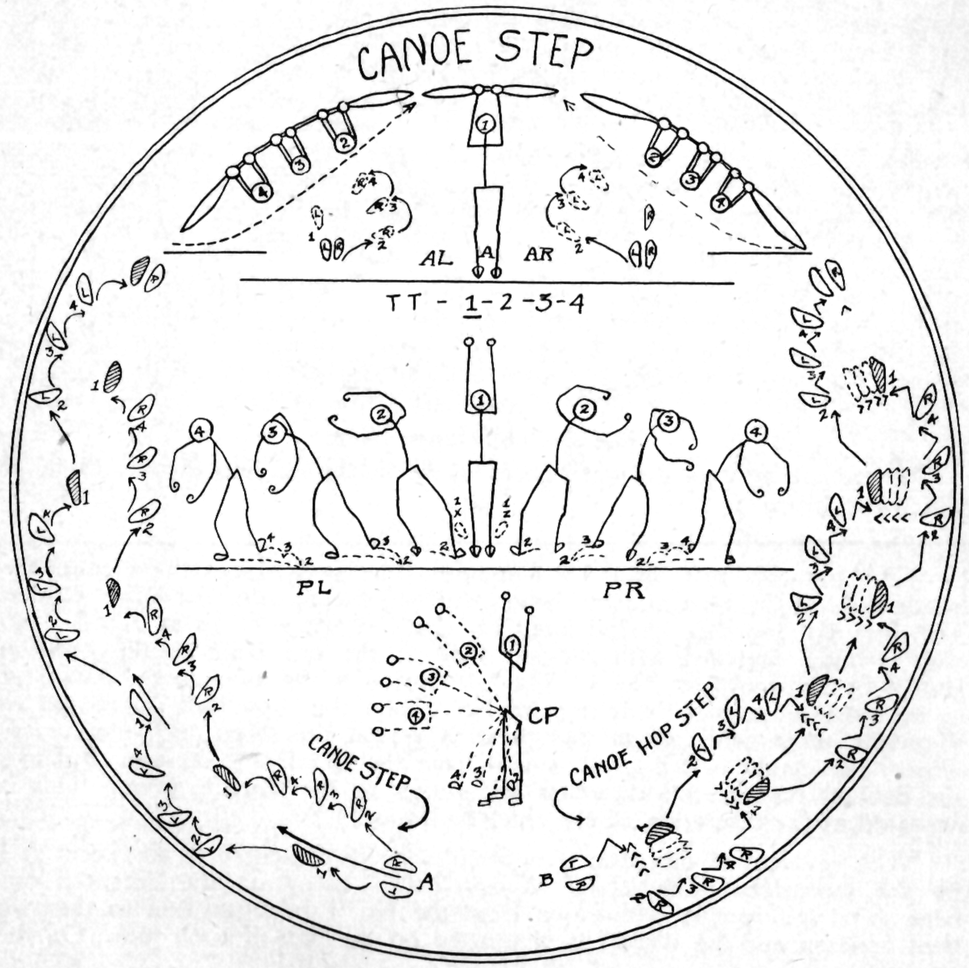


This step is shown in Fig. 4. The tom-tom beat is also a **1**-2-3-4, as described in the stamp step. The body faces the center of the circle, with the fists and arms at the thrust position. The feet are together as indicated by the footprints at point E. On the one beat the left foot is placed a little forward and to the left, see footprint L-1. The right foot is moved to a position behind the left foot as shown by the footprint R-2 on the two beat. The left foot is carried to the position shown by the footprint R-4. This completes the cycle. The movements are indicated beat by beat in the posture figures also by the footprint series shown at points A-B-C-D.

Canoe Steps

There are two types of Canoe Steps shown in Fig. 5. The tom-tom beat is a **1**-2-3-4 tempo as used in the two preceding dance steps. The body faces to the left along the circumference of the circle. The feet are together as indicated by the footprints at point A. Step forward with the left foot on the one beat. Tap the floor with the right foot in the position shown by the footprints R-2-R-3-R-4 on the two, three, four beats. Place the right foot forward on the one beat and tap the floor with the left foot on the two, three, four beats in the position shown by the footprints L-2-L-3-L-4. This constitutes the cycle for the foot work.

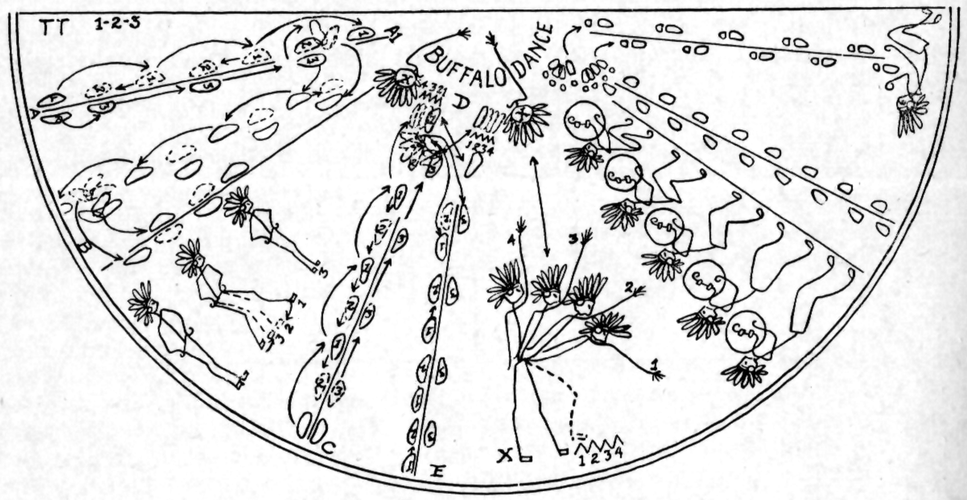
Both hands are held over head in the position that a canoe paddle would be grasped. On beat one as the left foot is set forward, the arms



are brought downward. In three movements which correspond to the 2-3-4 beats, the stroke of a canoe paddle as it is dipped and pulled through the water is depicted. The hands are raised overhead on each one beat. and descend to the opposite side. The action represents a canoeist paddling and steering a canoe.

The top figure in the Canoe Step circle position AL shows the numbered footprints and the corresponding arm and hand positions as the hands descend to the left. Position A-R shows the same thing as the hands descend to the right. The posture figures in the central group P-L and and P-R show the relative arm and body positions and the corresponding steps. The lower figure C-P is a composite posture.

The Canoe Hop Step follows the same pattern developed for the Canoe Step. The start is indicated at point B. Hop forward with the left foot on the one beat and continue to hop with the left foot for the two-three-four beats while tapping with the right. Then hop forward one step with the right foot and continue to hop with the right for the one-two-three-four beats while tapping with the left foot. The hand movements are the same as described above. This completes the circle for the Hop Canoe Step.



The Buffalo Dance Step

There are several distinct figures given in the Buffalo Dance, three of which are given here.

I. **The Approach Step.**

The tom-tom beat is a 1-2-3 tempo. The body faces the center, the hands rest on the hips and the head is turned facing over the left shoulder. The feet are together as indicated by the footprints at point A. A long step is taken forward with the left foot on the one beat, to the position shown by the footprint No. 1. The left foot is withdrawn on the two beat to the position shown by foot print No. 2 and the right foot is brought to it on the three beat. From this position repeat the steps until the dancer is near the center. At a given signal from the Chief or Tom-tom drummer the dancers reverse this direction and return to the starting point. This is repeated at the discretion of the chief or leader.

The reversal of direction is accomplished as indicated at the point A-1 by the footprints. The signal Wakan-2-3 is given on the accented one beat. The left foot is withdrawn from the No. 1 beat position to the two beat position and the weight is supported on the ball of each foot. On the

three beat the body swings around, pivoting on the balls of both feet, and the body faces outward. On the one beat the right foot is advanced and is withdrawn part way on the two beat. The left foot is brought up beside the right foot on the three beat. See the numbered footprints between points A-1 and B-1. The path of the dancer into the center and back to the circle is on the same radial line, although it is shown shifted to the right in the figure for the purpose of avoiding confusion in the footprints. The reversal is accomplished at point B-1 in the same manner as described for point A-1. At the signal Wakan-2-3 the right foot is withdrawn from the No. 1 beat position to the two beat position and again pivoting on the balls of the feet the body faces about on the No. 3 beat. The approach step is again made with the left foot as described above. This completes the cycle.

II. **The Petition.**

This action in the figure takes place at the center of the circle. At a given signal—Hands 2-3 (or another word), the tempo changes to a loud beat, twelve of which are used. The left foot is stamped four times, once to each loud tom-tom beat and the left hand extended is thrust downward toward the center of the circle at an angle of approximately 45 degrees on the first beat. The left hand is thrust horizontally outward toward the center of the circle as the foot is again stamped to the rhythm of the tom-tom. The third stamp and thrust of the hand is upward at about 45 degrees. On the fourth beat the hand is raised vertically overhead. A hop step is made which brings the right foot forward. The right hand makes four thrusts as described for the left hand while stamping the right foot on each tom-tom beat. Another hop is made bringing the left foot again forward and the stamp step and the hand thrust is repeated. The tom-tom beat changes to the 1-2-3 tempo and the dancer returns to the starting point at the circumference of the circle. The footprints for the petition are shown in Fig. 6, point D. The composite figure shows the body. Arm and foot work is shown at point X.

III. **The War Whoop.**

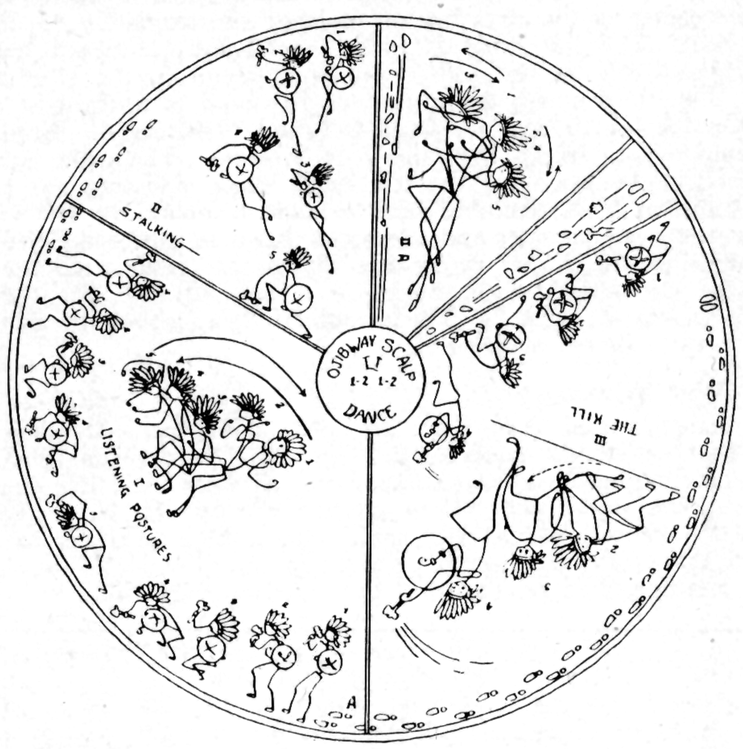
This action is used to conclude the dance and disperse the dancers. The tom-tom beats a steady unaccented 1-2, 1-2. The dancers approach the center on a running walk, crouching down as they near the center. The leader gives the signal and a low pitched war whoop is started by the dancer at the center, which rises rapidly to a high pitch as the dancers arise from the crouching position and jump into the air. They disperse, using the Hunting Step or Toe-Heel described on page 501.

The Ojibway Scalp Dance

This dance depicts the exploits of a successful warrior or hunter, and while it introduces no new steps it does introduce the pantomime of a hunter's action in locating, stalking and killing game, or scalping his victim.

I. The Listening Posture.

The dance step is the hunting step or the toe-heel step for which the tom-tom beat is a **1**-2; **1**-2. The formation is a circle dance, the dancer facing along the circumference. From this step the hunter enters the listening posture as indicated in Fig. 8-I. At point A the hunter has appeared, dancing the toe-heel step. At point 1 his body is erect. He begins to crouch as indicated at point 2. At point 3, his right knee is on the floor and at point 4, both hands are on the floor and he is preparing to place his right ear to the floor as indicated at point 5. The hunter then arises as indicated in Sketches 3-4-5, 4-3. The arms and body continue to move to the rhythm of the tom-tom. All body and arm movements are made with the same pulsating motion used in the toe-heel step.



II. Stalking Posture.

At a given signal from the drummer, one loud beat on the tom-tom, all dancers stop the toe-heel step, and throw themselves upon the floor along radial lines, with the left foot extended and pointing toward the center of the circle. The weight of the body is resting on the right thigh and right forearm. The shield is carried on the left arm and the tomahawk is held in the right hand. The tom-tom beat is an unaccented 1-2-3-4 and a pause. The dancers creep toward the center of the circle while the tom-tom is sounded and remain still during the pause. The movement is accomplished by placing the right hand on the floor and raising the body slightly. The

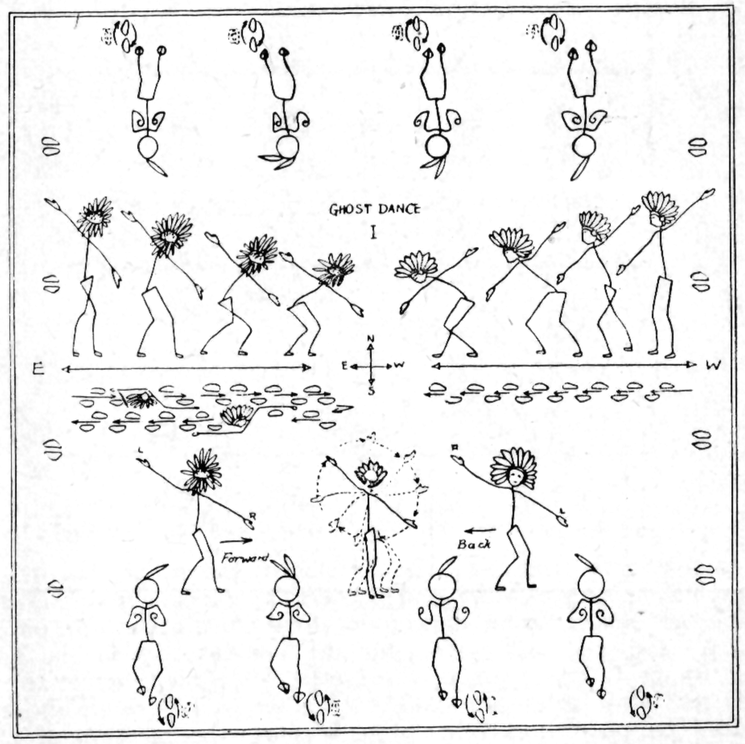
weight is shifted to the extended left foot and right hand, while the right thigh is lifted and shifted forward. This is repeated until the dancers are about three feet from the center of the circle.

During the pause the dancers crouch lower in order to avoid detection. The action is based on native observation. A snake stalking a bird affords the situation to be portrayed. While the bird sings the snake creeps. His motion is not likely to be detected while the bird is singing. When the bird stops singing and looks about the snake is quiet. Any motion then would be readily noticed. This posture should not be hurried and is most effective when done slowly. Sketch II indicates the body position, showing the relative elevation of the body during the cycle.

III. The Kill.

When the hunter reaches striking distance of his game (or the warrior, his enemy), he gradually raises to a crouching position and with the tomahawk poised, waits for the proper moment and strikes. The one blow dispatches the quarry and the hunter dances triumphantly about his meat, using the toe-heel step and shouting his exultation. The posture may conclude a dance and the dancers disperse following the kill.

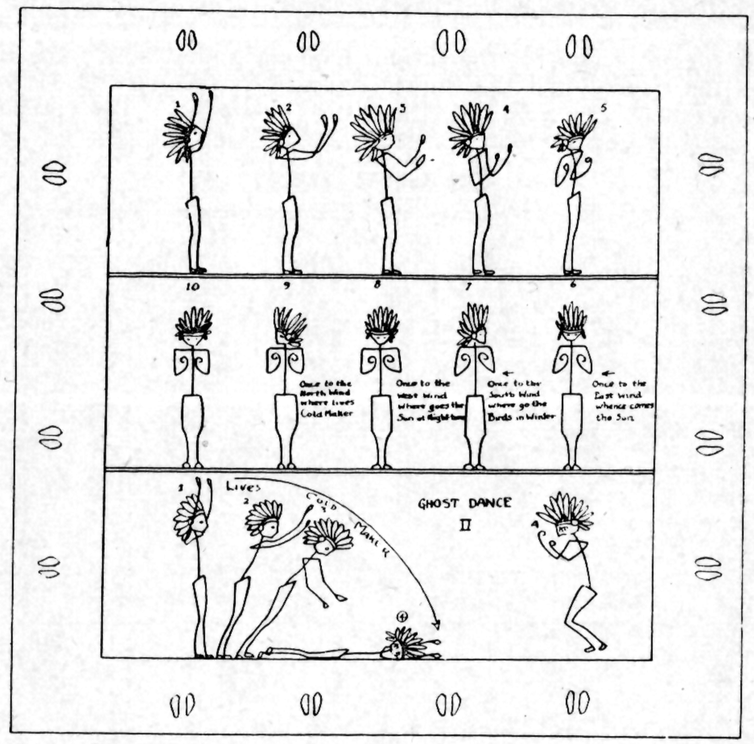
The Ghost Dance



The basic figure of the Ghost Dance is a square. The dance steps used are the Grape Vine, page 502, and the Running Walk, shown above. An equal number of dancers are used on each side of the square which is positioned on the cardinal points of the compass. The dance may be started from a standing position, using the Sage Chicken Hop, 1 and 11, page 500, or it may be started by using the Grape Vine Step, page 502. The arms are held at the thrust position. The dancers dance in place. The tom-tom beat is a **1**-2-3-4. Upon a given signal, the dancers move to the left or right as predetermined, preserving the square formation at all times.

Upon another signal the movement of the dancers around the square stops and they all dance in position, i. e. holding their respective places in the square. Another signal is given and the dancers on the north and south lines continue dancing in position, using the grape vine step.

Meanwhile the dancers on the east and west sides of the square approach each other on a running walk, see Fig. 1. The right arm extends forward and downward while the left arm extends backward and upward at an angle of about 45 degrees. The dancers are standing to their full height while in position on the side of the square. As they approach the center line of the square they crouch to a low position, see points E. W. Fig. 1. At a given signal the right arm is extended backward and upward while the left arm is extended forward and downward and the line of dancers back step on the running walk to the side of the square. This



approach to the center and return to the side of the square is repeated. All dancers resume the Grape Vine and proceed to dance, moving to the right or left until the dancers who danced in place during the approach to the center occupy the east and west position. The dancers in the north and south sides dance in place, using the Grape Vine step, while the dancers on the east and west sides approach the center as before. This movement is repeated. The posture sketches, Fig. I, show the position of the hands on the forward and the return position of the running walk, to the center and back.

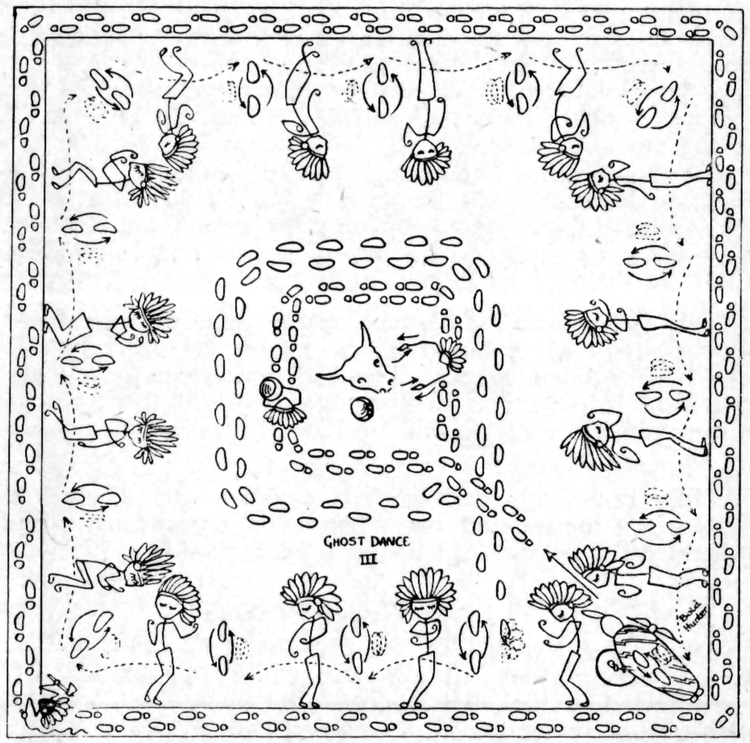
The Petition

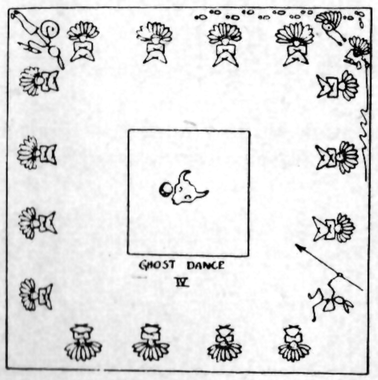
The position of the dancers around the sides of the square are shown in Fig. II. The posture figures are shown in Sketches 1-10. At a given signal the dancing stops and the hands, palms opened, are raised overhead. The face is turned upward as the hands are raised. The tom-tom beat is a steady tempo, of very low tone while the hands and head are uplifted. The Chief makes his petition to each direction in a strong voice.

The hands are lowered in four distinct movements as indicated by Sketches 2-3-4-5. The head remains bowed and the clenched fists tap the breast and the head is swung to the left, then front, right, and front. See Sketches 6 to 0. The hands are raised and lowered in the same manner after the Chief makes his appeal to each of the directions.

"Once to the East Wind, whence comes the Sun."
"Once to the South Wind, whence go the birds in Winter."
"Once to the West Wind, whence goes the Sun at night time."
"Once to the north Wind, where lives Cold Maker."

As the Chief makes his petition to the North Wind, the dancers bring their hands down gradually during the petition and on the word lives, which is long drawn out, the dancers all fall forward. After the words Cold Maker are uttered, the bodies strike the floor with a thud and the dancers remain in the prone position. The posture figures, lower Sketches, Fig. II, show the manner of falling forward and striking on the palms of the hands to break the fall and prevent injury.





The dancers are lying in the prone position shown in Fig. III as the solo dancers appear. A black spirit appears on the outside of the prone dancers and is seen quietly dancing, using a toe-heel step. A bold hunter enters the square at one corner carrying his shield, bow and arrows and wearing a blanket. As he enters the square he is very deliberate in manner and looks about him undisturbed by the black spirit. He extends his arms horizontally and the blanket drops to the floor. The hunter commences a light graceful toe-heel step and proceeds to the space in the center of the square, which contains a buffalo skull and a pan of incense. He dances once around the skull and lifts it above his head for a moment, places it again on the floor. He solo dances about the skull, using the reviving posture for a few steps, then picking up the incense pan, dances once around the inside of the square and replaces the pan by the skull. The high step is used while the hunter carries the incense pan. The hunter again tries to revive the buffalo by blowing his breath into the nostril cavities. Afterwards the hunter dances to a point between the bodies of the dancers and begins a grape vine dance. The bodies should be separated and in straight lines so that the dancer can step over them on the one step. The hunter dances over the bodies traversing the square and repeats the dance if time permits. As the dancer steps over the dancers the second time the prone dancers come to a seated position as indicated in Fig. IV. When the hunter arrives in the corner all the dancers are seated. The Chief, impatient with the hunter's failure to revive the buffalo, rises and hurls a spear across the floor, towards the hunter, who is mortally wounded. He drops his weapons, staggers while clutching his wound, and tries to continue his dance. Finally he drops to his knees, sways and falls lifeless to the floor.

The black spirit, who has been dancing quietly beyond the square, now enters the square of seated warriors. He dances around the body and starts to remove the fallen hunter. The seated warriors disapprove and the Black Spirit turns his attention to them. He flourishes his black horse hair whip at them, causing them to fall back to the crouched position on the floor.

The White Spirit advances from a distance and subdues the Black Spirit, removes the hunter and takes him to Shadow Land. The dancers arise and dance off the stage.

Solo Dance Postures

Solo dancing is a vehicle for the expression of individual moods and for dramatic interpretation. Couple the vivid imagination of a keen observer, possessing in the highest degree the muscular coordination of a trained athlete with the rhythm of a tom-tom and you have the solo dancer at his best. Ability to suit the action to the deed developed the art of pantomime to such a state of perfection that it becomes a means of communication, and led to the development of the sign language of the American Indian.

The solo dancer is at liberty to dance with complete freedom in any desired direction using steps that suit his mood, and is restricted only by the limits of the dancing arena.

Several of the postures used in solo dancing are shown in Fig. 7. The dance started at the point A and the toe-heel step was used to cover the distance to point B. At point B a brief pause was made while the dancer shaded his eyes and sighted around in search of game or the enemy. Meanwhile he continued to keep up the rhythm by dancing the toe-heel step in one place, as indicated by the footprints at point B. From point

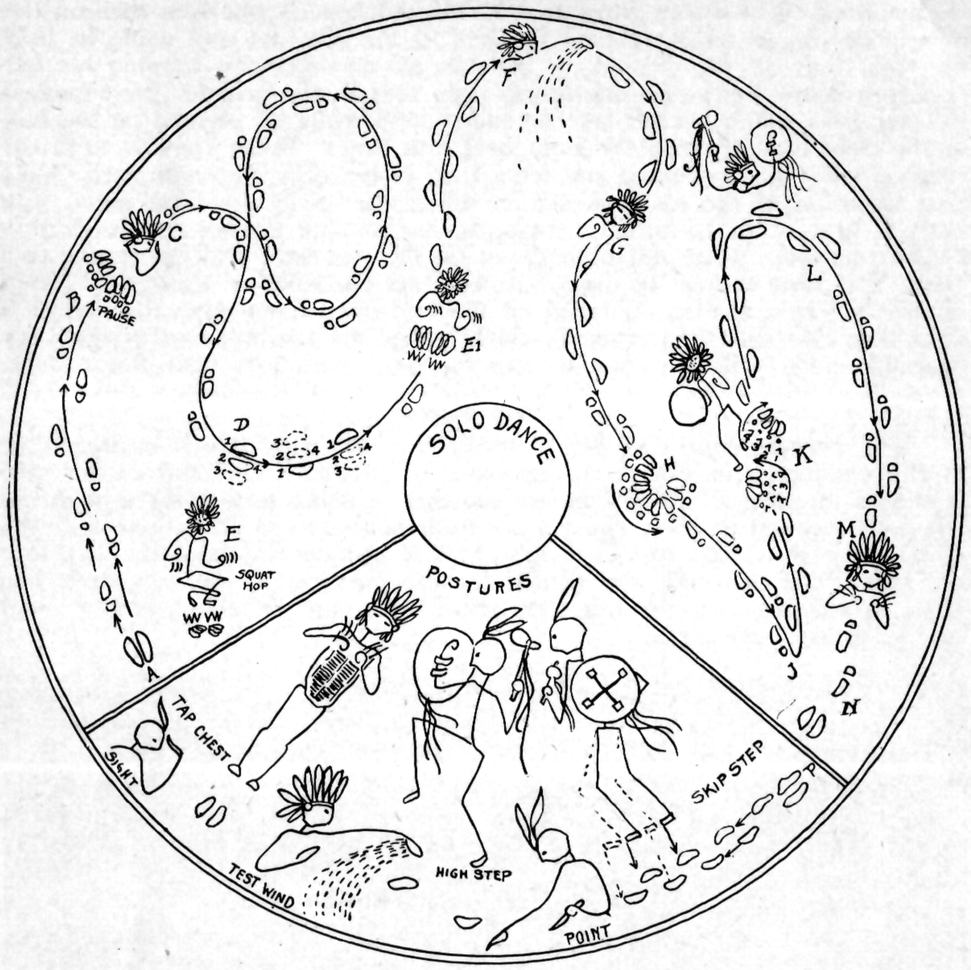


Fig. 7

C to D the dance followed a circuitous path using the toe-heel step. At point D the tempo was changed from the **1**-2—**1**-2 beat of the toe-heel step to a **1**-2-3-4 and the stamp step was used. At the point E-1 the Squat Hop Step was used, and the posture of the squat hop is shown at point E. The fists are clenched, the arms are in the thrust position, and the body is balanced on the balls of the feet. The hops or jumps are made vertically and both feet leave the ground. Sometimes the dancer carries a rattle or war club with which he pounds the floor during the hop step. This posture is used to express displeasure and is very effective when accompanied with low guttural growls and other derisive vocables.

From point E-1 to F, a running walk step was used during which the dancer stooped to the ground and grasped a handful of dust. This was raised above his head and allowed to fall, a device used to determine the direction of a wind, vital information needed when approaching game. From point F to G the running walk was used and the dancer was following tracks as indicated by the pointing posture at G. This tracking continued to point H, when apparently the tracks were lost as the dancer changed to the hunting step, pausing to look about him as indicated by the footprints at H. From H to J it is apparent that the dancer, still using the toe-heel step, danced backward as indicated by the footprints. From J to K the running walk step was used. At K the dancer was apparently in a very

happy mood. The tracks show that he danced first on one foot then on the other. He placed his weight on the ball of his left foot and while he held the right foot off the ground, he pivoted on the left foot, tapping his left heel four times, before he placed his right foot to the ground. He repeated the step by holding his left foot off the ground while he pivoted on the ball of the right foot, tapping the right heel four times. From point K to L the running walk was resumed, and from L to N the high step was used. This is a variation of the toe-heel step in which the knees are lifted high. The body is erect and the forearm swing in a chopping motion to the rhythm of the tom-tom. They are both down on the one beat and up on the two beat. The knee is bent or dipped forward as described in the toe-heel step on the one beat and straightened on the two beat. This gives the dancer a light bouncing springing motion, which makes the toe-heel dance step very graceful and a welcome change from the more strenuous solo dance steps.

Skip Step

The posture figures in Fig. 7 indicate a skip step which is useful for quickly changing position from one place to another. The start of this step is shown at point P. Both feet are together, a short step is taken with the left foot forward and the right foot is carried forward about one half the distance of the left step. The right foot is not carried past the left foot but lags about one half step behind for the duration of the skip step. The cycle is indicated for the left foot above, but may be changed to a right foot advance if preferred.

Senior Scout Group—Troop 10 B. S. A.
Pikes Peak Council 1934

Upper row—Robert Glew, Robert Bruce, Richard Brooks, Carroll Bullock, Ted Butterfield.

Lower row—Harold Whitney, Howard Brooks.